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Engineering-Science, Inc, Berkeley, Calif

Prepared for

Environmental Protection Agency, Denver, Colo Region VIII

Apr 78

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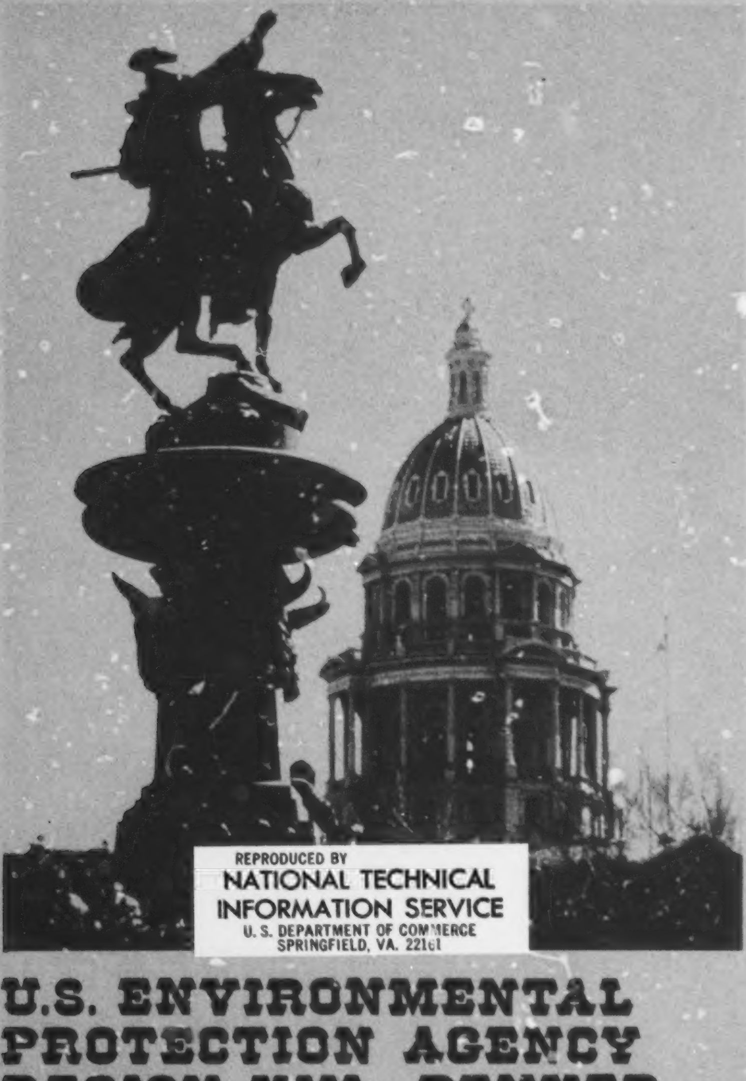
VOLUME 2: ANALYSES, COMMENTS
AND RESPONSES
EPA-908/5-77-001B

FINAL

DENVER REGIONAL ENVIRONMENTAL IMPACT STATEMENT FOR WASTEWATER FACILITIES AND THE CLEAN WATER PROGRAM



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16. ABSTRACT

This is the final environmental impact statement (EIS) prepared by EPA for the Denver Region concerning actions to be taken on 10 wastewater facility plans and the Denver Clean Water Plan (208 Plan). This EIS addresses the regional effects of these projects and the 208 Plan considering both direct and secondary impacts. Emphasis is given to the regional and cumulative impacts of population growth and development through the year 2000 which these projects and plans anticipate. The regional impacts on air quality, water quality, recreation, sensitive lands, agriculture, economy, and energy are examined. Volume 1 addresses the most important issues and EPA proposed actions. Volume 2 contains the detailed analysis of impacts, comments received on the draft EIS and EPA's responses to comments.

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VOLUME 2: ANALYSIS, COMMENTS
AND RESPONSES

FINAL

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DENVER REGIONAL
ENVIRONMENTAL IMPACT STATEMENT

for

WASTEWATER FACILITIES
and the
CLEAN WATER PLAN

Prepared by

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION VIII, DENVER

April 1978

Approved By:
Alan Merson
Regional Administrator

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I. Introduction

SECTION I

INTRODUCTION

The Denver Metropolitan Area includes nearly 60 percent of the population of the State of Colorado. It is located geographically near the middle of the state where the eastern plains of Colorado meet the Rocky Mountain foothills (see Figure I-A and Map A)*.

BACKGROUND

In 1969 a law of far-reaching significance for federal agencies was passed by Congress. This law, called the National Environmental Policy Act (and referred to as NEPA), requires a federal agency to take account of and make known the environmental impacts of any major action it is about to undertake. The vehicle used to do these things is a document called an environmental impact statement (EIS).

The Environmental Protection Agency (EPA) is responsible for seeing to it that many of the environmental laws passed by Congress are put into effect; however, it is also one among many federal agencies which must comply with NEPA in its own actions.

In 1972, EPA became responsible for implementing the Water Pollution Control Act Amendments (PL 92-500). This law, among other things, established water quality goals for U.S. waters:

1. "... wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983" and

2. "... that the discharge of pollutants into navigable waters be eliminated by 1985".

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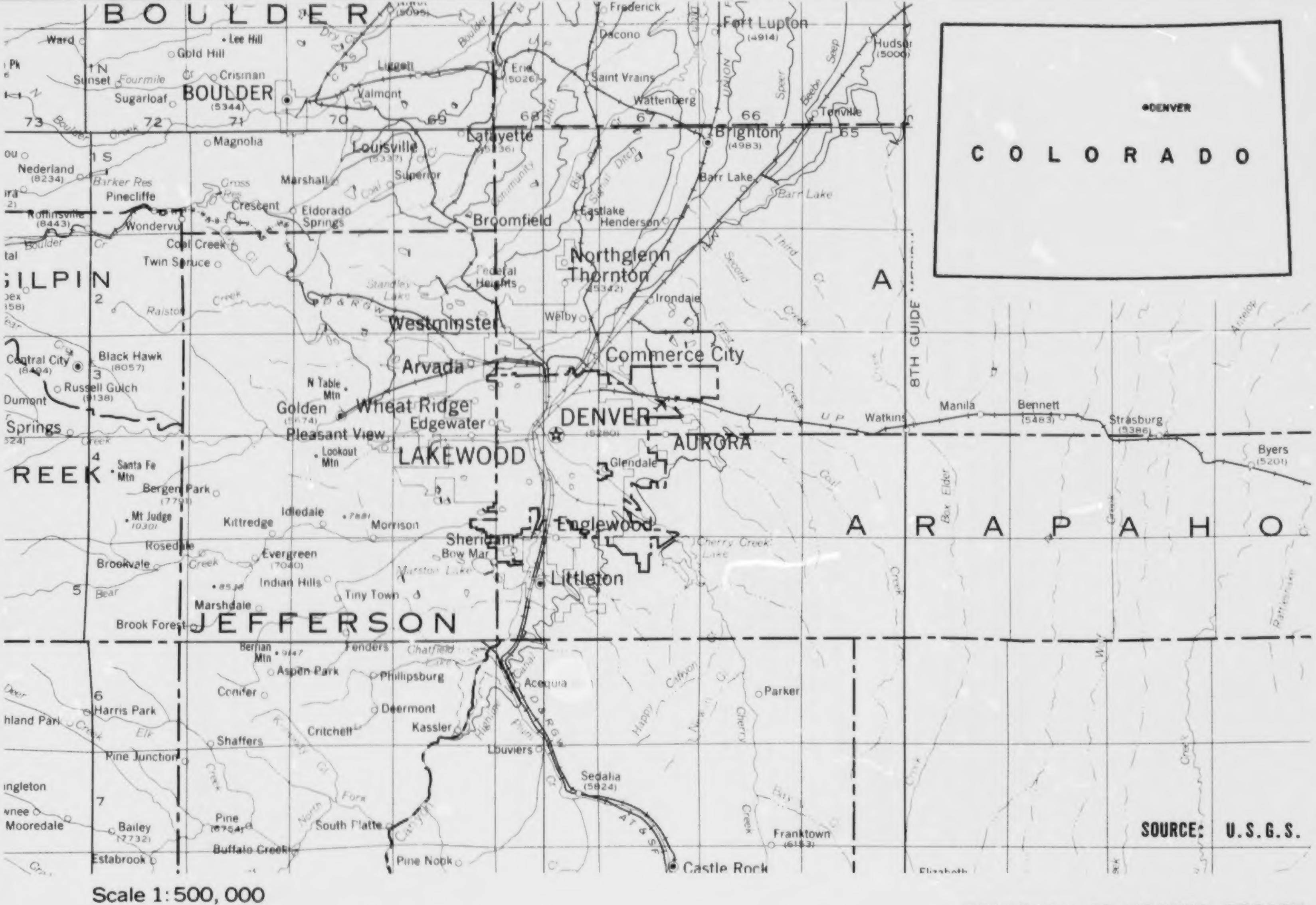
*All maps referred to can be found in the Map Folder supplied with this report.

FIGURE 1-A


COLORADO
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Arvada
Wheat Ridge
Golden (5674)
Edgewater
Pleasant View
Lakewood
Denver (5280)
Aurora
Commerce City
Northglenn
Thornton (5342)
Glendale
Englewood
Sheridan
Bow Mar
Littleton
Lafayette (5236)
Louisville (5337)
Superior
Brighton (4983)
Fort Lupton (4914)
Hudson (5000)
Manila
Bennett (5483)
Strasburg (5386)
Byers (5201)
Watkins
Parker
Franktown (6183)
Castle Rock
Sedalia (5824)
Evergreen (7040)
Morrison
Central City (8494)
Black Hawk (8057)
Nederland (8234)
Bailey (7732)
Scale 1:500,000
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RELATION OF DENVER REGION
TO THE STATE OF COLORADO

The law set up a comprehensive planning process involving EPA and individual states to define the necessary stream water quality standards and treatment levels to achieve these goals, and determine how they would be attained. The law created the National Pollutant Discharge Elimination System (NPDES) of permits to regulate and control discharges to the nation's streams. Congress also set aside $18 billion in grant funds to pay 75 percent of the eligible costs of publicly owned waste treatment works to assist municipalities in achieving the necessary wastewater treatment plant effluent quality to meet the water quality goals.

New amendments were enacted in 1977 changing the name of the law to the "Clean Water Act". More importantly, the 1977 amendments authorized the expenditure of an additional $19.5 billion in grant funds for publicly owned wastewater treatment works. The Water Act's deadline for municipal compliance with secondary treatment standards was modified to authorize EPA extensions, on a case by case basis, to July 1, 1982. If a municipal system will use innovative treatment methods, extensions could be granted to July 1, 1983. The amendments also delete funding for separate stormwater runoff sewer systems. In addition to encouraging innovative treatment technologies, the Act also emphasizes energy efficiency and consideration of system compatibility with recreation needs and planning.

The Environmental Protection Agency is charged with overseeing most of these and other provisions of the Act. Two areas of EPA responsibility under the Act are brought together in this EIS effort.

Section 201 of the Act provides for a three-step, facilities planning, design and construction approach to secure federal funds for municipal wastewater treatment works. Step I involves the development of a "facilities plan" that evaluates treatment needs, systems capabilities, alternatives and develops a preliminary design for the project. EPA is charged with review and approval of such Step I plans before design (Step II) and construction (Step III) funds can be obtained. An integral part of the EPA's review involves an assessment of environmental impact that the facility plan defines.

Section 208 of the Act is also administered by EPA. This is a special planning function that analyzes complicated water pollution problems on a regional or statewide scale. Where the governor of a state identifies a major water pollution problem, a "208 agency" is designated to develop a comprehensive Clean Water Plan to deal with the problem. 208 planning involves: defining point and non-point sources; projecting wasteloads; establishing treatment needs and priorities; evaluating stream classifications and determining the necessary controls and types of management to achieve the goals of the Act. Such a plan in effect will set many of the criteria to be met by individual 201 facilities plans for the study area.

ACTIONS UNDER CONSIDERATION IN THIS EIS

The 201 Facility Plans

Various local agencies have prepared or are developing facility plans to construct, improve and/or expand municipal wastewater collection and treatment systems for the following planning areas (see Map J):

1. South Adams County
2. Englewood and Littleton
3. South Lakewood
4. Cherry Creek and Goldsmith Gulch
5. Lower South Platte
6. Clear Creek
7. Sand Creek
8. Westminster and Broomfield
9. Northglenn (originally part of Lower South Platte planning area)
10. Metropolitan Denver Sewage Disposal District No. 1

Each of these wastewater treatment facility plans must identify the most cost-effective and environmentally sound alternative after considering the local and regional implications of the project.

Some of these facility plans are complete and the recommended alternatives are known. Other plans have been started, and still others have not yet been initiated. Table I-A briefly summarizes the status of the ten facility plans, and in the case of those not yet begun or completed, Table I-A presents the probable plan recommendation based on other sources of information. Detailed information on each facility plan can be found in Volume 2, Section III of this EIS.

Considered together, these projects raise significant regional issues which must be addressed, such as population levels and distribution, air quality, conversion of agricultural land, protection of environmentally sensitive areas, and point and non-point water pollution controls. There has been and continues to be a great deal of discussion between citizen groups and various levels of government concerning the best way to address these regional issues. The concept of a regional environmental study has been developed as one possible way to evaluate these issues. EPA's policy in the past has been to evaluate wastewater treatment facility plans in the Denver Metropolitan Area on a project-by-project basis and to prepare the

Table I-A. SUMMARY AND STATUS OF DENVER REGION 201 FACILITY PLANS (1978)

Service Area	Expected Plan	Status of 201 Plan
South Adams	Maintain existing plant, Phase I expansion from 2.5 to 4.25 mgd in 1978, Phase II expansion to 6 mgd by 1986. Nitrification by land application via discharge to O'Brian Canal and Burlington Ditch.	Complete, Phase I under construction. Phase II not acted on by EPA.
Englewood/Littleton	Addition of ammonia and chlorine removal and expansion to 30 mgd capacity by 1982. Further expansion of joint plant to total capacity with AWT to 40 mgd in 1993.	In preparation
South Lakewood	Enlarge existing plant, improve sludge handling facilities; capacity expanded from 2 mgd to 3 mgd.	Complete, under EPA review.
Cherry Creek/ Goldsmith Gulch	System of interceptors to expected 1985 flow from upper Cherry Creek to Northside/MDSDD#1 complex. Provision for AWT satellite plant in 1985.	Complete, under EPA review.
Lower South Platte	New plant for flows from Brighton, 1st, 2nd and 3rd creeks. Lower Thornton flows to Westminster's Big Dry Creek plant for agricultural exchange. Remainder of the area flows to MDSDD#1 and South Adams County Water and Sanitary District.	Complete, under EPA review.
Clear Creek	Parallel Clear Creek interceptor to transport all basin flow to MDSDD#1 for treatment.	Complete, under EPA review.
Sand Creek	Expand existing Aurora plant from 1.5 to 2 mgd with reuse. Remainder of area flows to MDSDD#1.	Complete, under EPA review.
Bloomfield/ Westminster	Expansion of existing Big Dry Creek Plant to 9 mgd by 1985 with land application/agriculture reuse.	A plan was completed in 1975 but rejected. Work on new plan suspended.
Northglenn	All wastewater flows plus some stored surface runoff to new Bull Canal Reservoir for pretreatment and storage of use in agricultural exchange.	In preparation
MDSDD#1	Addition of ammonia removal for total plant capacity of 190 mgd by 1983. Option for reuse.	In preparation

individual project environmental impact statements, if necessary. The analysis of regional issues and secondary impact questions has been difficult using a project-by-project approach. EPA acknowledges this difficulty in the final EIS for the present plant expansion by the Metropolitan Denver Sewage Disposal District No. 1 plant (MDSDD #1) (February 1974), in the final EIS for the Englewood-Littleton sewage treatment plant (August 1974), and in the negative declaration for the South Platte II interceptor sewer (September 1975) where EPA indicated the intention to prepare a regional environmental impact statement addressing these broader issues.

As indicated above, there are other wastewater treatment projects that are in various stages of construction, some of which have been the subjects of individual EIS's. Although not directly affected by the EIS effort, it is EPA's intention to apply where possible, any reasonable mitigating measures to any of those projects beginning or still under construction. The on-going Denver area projects not directly covered in this EIS are as follows:

1. City of Boulder's wastewater treatment plant improvement program. Final EIS in preparation;
2. City and Count of Denver's interceptors in the Harvard/Jewell area which are now under construction;
3. City and County of Denver's parallel Delgany interceptor, and storm and sanitary sewer separation projects to be constructed;
4. City of Westminster's Big Dry Creek plant expansion now being constructed;
5. MDSDD #1 central plant expansion now in operation;
6. MDSDD #1 sludge disposal plan now being finalized for funding, final EIS in preparation;
7. New regional plant and interceptors for Littleton and Englewood; and
8. MDSDD #1's Platte River II interceptor now under construction.

The Clean Water Program (208 Plan)

The Denver Regional Council of Governments (DRCOG) was designated the 208 planning agency for the Denver area to address the complicated water pollution problems in this highly urbanized area.

The DRCOG 208 study, named the Clean Water Program, has evaluated the national goals and their attainability in the Denver area with respect to financial, environmental, social and economic impacts. It has also attempted to determine technical solutions to regional environmental problems and recommended a management system for implementing the Clean Water Plan.

As an integral part of the work effort of the Clean Water Plan, population allocations and a land-use plan have been developed by DRCOG, as well as a set of recommended treatment plant funding priorities and levels of quality for plant effluents. An assessment of the non-point source problem as it affects meeting the national goals is also included in the plan.

The draft of the Clean Water Plan was released in April 1977 by DRCOG. The final recommended plan was approved and adopted by the Denver Regional Council of Governments on July 24, 1977. The Governor of the State of Colorado approved the plan with conditions and transmitted the plan to the Regional Administrator, EPA Region VIII for review and approval on January 11, 1978. EPA has until May 11, 1978 to act on the Clean Water Plan. This EIS explains EPA's proposed major actions on the plan. However, final action will not take place until after a 30 day review of the final EIS.

THE NEED FOR THIS EIS

As mentioned briefly, EPA is concerned about the piecemeal manner in which its NEPA reviews of earlier projects have proceeded. Regional or secondary impacts simply could not be adequately discussed at the project level. The preparation of this regional environmental impact statement has allowed EPA, local, state and regional governments and the public the opportunity to address these significant issues.

Air Quality and Water Quality Planning Consistency

The regulatory aspects of EPA's activities under the Clean Air Act relating to transportation control plans to achieve air quality standards may not require a NEPA evaluation. However, EPA has come to realize that activities in different media programs need to be consistent, such as in this case where there must be a consistancy between air and water pollution controls.

The Denver Air Quality Control Region (AQCR) is currently in violation of ambient air quality standards for carbon monoxide, particulates and ozone. A transportation control plan (TCP) has been adopted by the Colorado Air Pollution Division, Department of Health and EPA. Implementation of the various control strategies to date has been very limited and air quality standards will continue to be violated over the next several years even with controls.

The Clean Air Act Amendments of 1977 will require changes to the State Implementation Plan (SIP). These changes must be submitted to EPA by January 1, 1979. EPA must approve or disapprove the changes by July 1, 1979, and develop alternative plans for those changes it disapproves. An important part of the SIP, the Transportation Control Plan (TCP), is now being revised. Under the 1977 amendments, it must include all "reasonable" carbon monoxide and oxidant control measures to be implemented by 1982. If air quality standards would still not be met, another plan including all "necessary" measures to attain standards by 1987 must be submitted by 1982. The new SIP must include the effects of future growth when demonstrating the attainment and maintenance of air quality standards. If mandated SIP revisions are not submitted or are not complied with, federal sanctions can result, thus limiting federal assistance and the granting of permits.

In regard to facility planning, the environmental issue of note becomes this: to what extent does the population growth planned for in sewage treatment plant and interceptor capacity relate to further VMT growth in the Denver Metropolitan Area? Is the planning for treatment plant capacity consistent with air quality maintenance plans? Among available control strategies, the Clean Air Act provides for land-use controls, if necessary, to achieve and maintain air quality standards. Thus, it is necessary to look at projected population growth in terms of: a) total growth; b) the distribution of this growth and the resulting transportation needs and patterns; and c) how these future development and transportation patterns would impact air quality. Such projections for growth, size and distribution are, of course, an essential element of facilities planning for sewers and wastewater treatment plants. EPA feels that its approach in these two areas of environmental protection must be consistent.

Impacts of Growth on Achieving Water Quality Standards

Planning for future growth means that more sewage and other forms of water pollution must be accounted for and controlled. In particular, non-point sources (those diffuse pollution sources not developed or released at a definable single point on a stream or lake -- e.g., stormwater runoff, agricultural return flows, lawn watering and car washing) must be accounted for in calculating the total impact on a stream quality.

In order to properly plan for wastewater treatment facilities, one must know:

- what degree of treatment is necessary at the plant;
- what are the other pollution sources on that stream reach which are also contributing to the problem;

- how can they all be controlled; and
- what is the likelihood and cost of attaining stream standards required under the Act?

The Clean Water Plan, developed by DRCOG and conditionally approved by the State, was developed at the same time as most of the facility plans. However, decisions on facility plans, such as a degree of treatment, type of treatment, location and population impacts, must have the benefit of the overall Clean Water Program. This EIS is an attempt to bring together these plans for EPA's evaluation of the total water quality picture for the Denver Metropolitan Area.

Relationships of Wastewater Treatment Plant Organization

Sixteen wastewater treatment projects are undergoing planning or construction at this point in time in the contiguous Denver Metropolitan Area. Virtually all of the separate facilities planning are inter-related in some fashion. Decisions on the upstream plants (South Lakewood, Cherry Creek, Clear Creek and Sand Creek) invariably involve maintenance or development of an upstream facility versus connection with a downstream facility, such as Denver Northside or MDSDD #1. In some cases (Westminster and Lower South Platte) potential decisions may involve a redistribution of flows between the separate districts. It is thus important to consider these individual options together and at a common point in time. EPA believes that it is possible to develop an overall policy, concerning satellite versus centralized treatment, which is consistent with other needs of the State, such as water rights, water supply, reuse and instream benefits.

Prime Agricultural Land Losses

This is a special land-use problem that is not only a regional problem, but a national one. The Council on Environmental Quality, rightly concerned with the problem, commissioned a special study to analyze the impacts of urban growth on the nation's farmlands. The study demonstrated that prime agricultural land is rapidly being converted to urban uses. In a qualitative way, EPA has been aware of similar problems in the Denver Metropolitan Area. Virtually all new housing development in the metropolitan area uses some form of agricultural land. The land varies from rangelands to dryland farms to irrigated farmlands.

The relationships between this loss of agricultural lands and facility planning is as follows: the projections used in facilities planning for new population increases and their locations will have a strong effect on the amount of farmland lost.

This is one more area in which EPA and other agencies have limited information with which to make a decision. Facility plans to date have not catalogued how much of the various categories of farmland will be converted by the future development. Therefore, EPA cannot estimate the magnitude of the problem except in general terms. This EIS will investigate on a regional level, how much area of the various categories of farmland will be lost to future development, how critical in terms of the overall state and national farming economy the loss of these lands are, and whether any specialty crops are involved that cannot or are not likely to be grown elsewhere. Only with this information can a set of reasonable strategies be offered for mitigating such land losses in facility planning.

Sensitive Environmental Areas

In planning for future growth, planners need to be aware of the potential impact of new population on environmentally sensitive areas unsuitable for development. Such a list of features would include:

- unusual geological features
- archaeological features
- historical features
- floodplains
- marshland/wetlands
- wildlife habitat areas
- natural vegetation areas
- steep slopes/unstable soils

The first problem is to recognize the commonality of these items from one service area to another. Many of the items in a given service area represent only a fraction of the total resources. There is a need to look cumulatively at the entire Denver region to assess how vulnerable these resources are. The EIS, in conjunction with the Clean Water Program information, developed an environmental sensitivity inventory that gives EPA an overall picture of the situation.

Socio-economic Impacts

This is an area that has received very little attention in past EIS efforts on wastewater facilities. The EIS attempts to identify any sociological or economic impacts, both beneficial and adverse, that could occur because of the overall federal investment pattern of construction grants in the Denver Metropolitan Area. The EIS addresses the conflicts between suburban districts and central facilities, and the potential influence that this federal funding program may have on urban land use form.

Land Treatment and Reuse in the Denver Metropolitan Area

EPA requires and encourages the consideration of land application and reuse of wastewater as potentially beneficial ways of achieving water quality standards and attaining other valuable environmental objectives, such as farmland protection and use of nutrients. Until now, land treatment has received limited evaluation in facility plans. Land treatment involves the discharge of treatment plant effluent onto the land surface where percolation through and interaction with the soil removes pollutants. The first comprehensive water quality management study (called the 303-e Plan) for the Denver Metropolitan Area eliminated land treatment because of high costs. The Clean Water Program reevaluated the potential for land treatment and reuse in the study area, and is encouraging land treatment and reuse systems.

Because of the scarcity of water in Colorado for municipal, industrial and agricultural uses, interest has grown in many Colorado communities in instituting some form of water reuse. Particularly in the fast growing areas, municipalities may be able to increase their domestic water supplies through an arrangement of "first use" by municipalities and subsequent use of wastewater effluent by agricultural concerns. Colorado water rights laws dictate to a large extent what kinds of "reuse" schemes are available to communities.

The effects on water quality may be beneficial, but it is not necessarily true in every case. Stream flows can be depleted as well as agumented. It will depend to a large extent on the type of reuse system involved. The issues involving plant organization are in some ways related to this issue. In this EIS, then, EPA will define the types of potential reuse systems, the specific situation as it occurs in Colorado, and impacts likely to occur for different systems. Eventually, decisions on the most beneficial types of reuse from a water quality standpoint may be influential in determining the satellite-regional plant arrangements.

THE OBJECTIVES OF THIS EIS

As an overall perspective, the following general objectives were identified for this EIS based on the preceeding discussions:

- To define and assess the environmental impacts of the ten Denver Metropolitan Area wastewater facility plans and the Clean Water Plan.
- To define EPA policy and decision options for assurance of consistency between EPA's air and water programs and goals of NEPA, including the options for mitigation of adverse secondary impacts; and

- To stimulate public discussion about "desirable" environmental goals for the Denver Metropolitan Area, with emphasis on the relationship of EPA's construction grants program to other federal, state, regional and local governmental programs.

The latter point deserves some further elaboration. EPA has extensively coordinated the preparation of this EIS with various state, local and federal agencies. For example, this EIS makes extensive use of information, data and analysis developed by the Clean Water Program planning effort. In addition, EPA has followed the U.S. Department of Housing and Urban Development's preparation of an EIS on its Federal Housing Administration program for Denver, and the U.S. Bureau of Land Management's revision to its draft EIS on the proposed Foothills Water Treatment Plant. In terms of growth related environmental issues, this EIS emphasis areas of EPA responsibility, such as air and water quality, and it intended to supplement work by other agencies. Thus, it is hoped that this EIS will help provide a focus for confronting growth related environmental issues of much concern to the State of Colorado and the citizens of the Denver region.

THE EIS PROCESS

The Draft EIS for Wastewater Facilities and the Clean Water Program was released for public review on June 3, 1977. Formal public hearings were held on July 18 and July 19, 1977. The public review period ended August 15, 1977.

The Draft EIS presented a number of environmental issues and impacts within the context of three overall alternative strategies that EPA was considering for adoption. The EIS stated that one of the basic EPA objectives was to stimulate the fullest possible public discussion and review so that one of the strategies could be evolved into a reasonable and prudent course of action for EPA to follow. To that end, an extensive public participation program was organized. A twenty minute slide presentation with a taped narration was used extensively for presentations before twenty federal, state, regional and local agencies, and special interest groups. Brochures and questionnaires were also used at these presentations. Newspaper supplements were distributed by the region's two major daily newspapers explaining the issues and providing a means for further citizen comment. A detailed analysis of citizen attitudes, based on the results of the public participation program, is presented in Reference 130. Some highlights from the findings of that analysis are:

- Air quality is perceived as the Denver region's most serious environmental problem.

- Air and water pollution, the loss of agricultural land and waste of energy resources are generally attributed to regional growth and to a regional land use pattern characterized as "sprawl".

- Significant institutional changes are thought necessary to correct these problems. Consolidation of local service districts, improvements in land use planning (strenghtened zoning, state assumption of responsibility for agricultural land preservation and more caution in extension of public services), and greater regionalization of certain functions (including establishment of regional service districts and regional tax base sharing) are widely seen as promising approaches.

- Federal funding from the Environmental Protection Agency is greatly needed for water quality improvement; however, there is disagreement on whether federal funds should be used to pay for water-water system expansions to accommodate growth.

- Public ignorance and apathy about environmental problems is an obstacle to the solution of those problems. The education of the public and public involvement in environmental decisions are seen as critical to the success of environmental improvement programs.

- The environmental problem that the Denver region faces are seen as inter-related, and solutions to those problems will require a degree of coordination among jurisdictions and levels of government beyond that now existing in the region.

II. The Existing Environment

SECTION II

THE EXISTING ENVIRONMENT

SITUATION AND DESCRIPTION OF THE DENVER REGION

The study area for this EIS is shown on Map A*. The semi-arid Denver region is located at the approximately 1,600 metres (5,280 feet) high western edge of the high plains province of Colorado. This portion of the Great Plains slopes upward 585 metres (1,930 feet) for almost 300 kilometres (186 miles), from the 1,020 metres (3,350 feet) high eastern state boundary to the abruptly rising foothills at the base of the Rocky Mountains. Relief is characterized by rolling prairie, with some hills and ridges intersected by level flood plains along the generally northeast flowing watercourses of the Platte River drainage. The South Platte River and Cherry Creek flow through the heart of Denver.

Approximately 1.5 million people (1975) live in the region. Regional growth reached a peak rate of 5.5 percent per year in 1972-73 and has since declined to a rate close to the 1960 to 1970 average of 2.6 percent. Population distribution patterns are changing as the central city continues to lose population to the suburbs (see Map B). Residential areas and their service facilities surround the commerce areas, with densities decreasing from the urban core to the suburban/rural edge of the region.

Denver is the state capital and is the major federal administrative center for the Rocky Mountain States. Government employment is considerable, with thousands of people employed by the state, the Rocky Mountain Arsenal and other government facilities. Transportation industries, such as aviation, trucking and railroads, are of major importance to the region's economy due to Denver's crossroads situation for many transportation routes. Commercial and industrial enterprises are concentrated in the urbanized areas, with many of them located in the Denver downtown area and along major streams. Agricultural activity is a significant part of the region's economy.

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* All maps referred to can be found in the Map Folder supplied with this report.

ENVIRONMENTAL SENSITIVITIES

EPA's purpose for this EIS is to examine the effects and issues of growth in the Denver area, so that it might determine whether or not it should contribute to the accommodation of this growth through its wastewater funding programs. Also, EPA must consider its administrative responsibilities in terms of the regional environment, and promote programs and strategies for dealing with physical environmental problems, such as air and water quality. To examine these problems, a mass of data and information on the Denver area has been edited to emphasize the major characteristics of the region that may affect or be affected by the proposed projects and the growth they will help accommodate.

Regional Climate

The Denver region, lying at the western edge of the Great Plains near the Rocky Mountain Foothills, is in an area of transition between the climate of the plains and that of the mountains. The region is situated within an area having a high-altitude, continental climate. Locally, the region's climate is that of semi-arid steppe.

Temperatures are generally moderate. The growing season is approximately five to six months long. Precipitation is relatively light, with a large portion falling during the April to September growing season. Much of the summer precipitation occurs as a result of thunderstorm activity, and heavy thunderstorms in the eastern foothills and plains area occasionally cause flash floods. Snowfall is generally not heavy. Extensive flooding caused by snowmelt in the nearby mountains occurs only at times when there has been either a heavy accumulation of snow or sudden high altitude warming. The generally low relative humidity is a major factor in the region's somewhat high annual evapotranspiration rate, which is twice the average annual precipitation.

Denver experiences infrequent and often destructive "Chinook" winds from the northwest during fall through spring. Chinooks, with velocities of up to 54 metres per second (120 miles per hour), blowing down from high-elevations are warmed by compression during their rapid descent through the shallow layer of cool air covering the plains. The sudden rises in temperature resulting from these gusty winds exert a moderating influence on winter temperatures. Chinooks are experienced in a 24 to 32 kilometres (15 to 20 mile) wide zone along the foothills. Although little information has been published which identifies areas of greatest wind velocities, it is recognized that winds during Chinook events are 1.3 to 2.2 metres per second (3 to 5 miles per hour) higher along the bottoms of the stream valleys than in the surrounding areas. Therefore, wind damages are also generally greater in the stream valleys. Ridges which experience higher than average velocities during Chinook events are shown on Map C. Construction activities are generally restricted during Chinook events, and wastewater treatment processes involving spraying are generally curtailed (Reference 126, 413).

Air Quality in the Denver Region

The following discussion will first present aspects of the climate in the Denver region which affect air pollution levels. Next, short discussions of health effects and effects on agricultural crops are presented. The last section will discuss current air quality and the sources of air pollutants.

Climatic Conditions Which Affect Air Quality --

Air quality in the Denver area is influenced primarily by the topography of the South Platte River Valley. The topography's associated drainage winds move down the valley to the northeast during the evening and then reverse during the mid-morning with upslope motion usually occurring during the remainder of the daylight hours. As the air flows across the city, pollutants generated at the ground surface are transported back and forth over the area increasing and decreasing the pollutant concentration. Fortunately, Denver's location on the east side of the Rockies means that pollutant containment by prevailing westerly winds does not occur, as it does in Los Angeles.

Solar radiation plays an important role in determing air pollution potential. The ultraviolet component of sunlight is the driving force that initiates the chemical reactions necessary to produce photochemical smog. Denver, at its "mile high" altitude, receives a higher amount of ultraviolet radiation because the thinner atmosphere does not filter out as much ultraviolet radiation.

Normally, the temperature of the air decreases with height above ground surface. When the opposite occurs, or temperature increases with height, upward movement of cold surface air is restrained by the "lid" of warmer air aloft. This condition is called an inversion. The altitude or depth of this inversion, in tens, hundreds or thousands of metres, determines the volume of air in which air pollutants are mixed and how concentrated they become. Denver is unusual because no city of comparable size in the nation has a lower morning inversion or a higher afternoon inversion. This means that air pollutants emitted in Denver's morning rush hour are trapped in a very thin layer of air. However, by afternoon, the volume of air has usually increased drastically as the inversion rises, and pollutants are thereby greatly diluted. Most severe pollution episodes occur when the inversion does not rise, and pollutants are trapped for a day or more in a relatively thin layer of air. These situations most frequently occur in winter.

Effects of Air Pollutants on Health --

The Clean Air Act Amendments of 1970 mandated that minimum standards of air quality be set to protect the public health and welfare of the population at large. The law requires that primary standards be set to protect the public health with an adequate margin of safety, and that secondary standards be set to protect the public welfare. Effects on public welfare are concerned mostly with plant and property damage.

The EPA, after a great deal of research, set standards for six pollutants. These are carbon monoxide (CO), photochemical oxidants (usually characterized as ozone), sulfur oxides (SO_x), nitrogen dioxide (NO_2), total suspended particulates (TSP), and hydrocarbons. Standards for all but sulfur oxides are shown in Table II-A, and the health effects of these pollutants are discussed below. Sulfur oxides are not discussed in this EIS, as they are not currently a problem in the Denver region.

Carbon Monoxide -- Carbon monoxide (CO) is a colorless, odorless, tasteless gas commonly found in urban atmospheres in concentrations that can be harmful to people. A by-product of combustion, the greatest single source of this pollutant is the automobile.

Carbon monoxide is inhaled through the lungs and enters the blood stream by combining with hemoglobin, the substance that normally carries oxygen to the cells. CO combines with hemoglobin much more readily than oxygen does. The result is that the amount of oxygen getting to the tissues is drastically reduced in the presence of CO, and this can have a profound effect on health. CO also impairs heart function by weakening the contractions of the heart which supplies blood to the various parts of the body. The effect of this on a healthy person is to reduce significantly his ability to perform exercise, but in a patient with hearth disease, who is unable to compensate for the decrease in oxygen, it can be a life-threatening situation. A person who has a heart attack in the presence of heavy carbon monoxide air pollution is more likely to die than if the attack had occurred in clean air. Carbon monoxide is also harmful to persons who have lung disease, anemia or cerebral-vascular disease.

Carbon monoxide can also affect mental function at relatively low concentrations of 30 parts per million (ppm). Visual perception and alertness can be affected.

TABLE II-A. NATIONAL AMBIENT AIR QUALITY STANDARDS[a]

Pollutant	Averaging Time	Primary Standards	Secondary Standards
Particulate matter	Annual (geometric mean)	75 μg/m^3	60 μg/m^3
	24 hour[b, c]	260 μg/m^3	150 μg/m^3
Carbon monoxide	8 hour[b]	10 mg/m^3 (9 ppm)	10 mg/m^3 (9 ppm)
	1 hour[b]	40 mg/m (35 ppm)	40 mg/m (35 ppm)
Nitrogen dioxide	Annual (Arithmetic mean)	100 μg/m^3 (0.05 ppm)	100 μg/m^3 (0.05 ppm)
Photochemical oxidants	1 hour[b]	160 μg/m^3 (0.08 ppm)	160 μg/m^3 (0.08 ppm)
Hydrocarbons (nonmethane)	3 hour (6 to 9 a.m.)	160 μg/m^3 (0.24 ppm)	160 μg/m^3 (0.24 ppm)

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[a] The air quality standards and a description of the reference methods were published on April 30, 1971, in 42 C.F.R. 410, recodified to 40 C.F.R. 50 on July 1, 1975.

[b] Not to be exceeded more than once per year.

[c] State standards for particulate matter:

24 hour, 150 μg/m^3; Annual, arithmetic mean, 45 μg/m.

Ozone -- Photochemical oxidants are responsible for a number of health effects in humans. They can affect the lungs and eyes. They may result in eye irritation with the familiar symptoms of tears and inflammation. At certain concentrations they have been shown to impair the performance of athletes, and to affect persons with asthma.

Ozone, the main constituent of photochemical smog, is a severe irritant to all mucous membranes, and its main health effects are on the respiratory system. It is virtually intolerable at levels of 1 part per million. At considerably lower concentrations (0.1 to 0.2 ppm), which often occur in the air of many American cities, ozone in conjunction with other photochemical oxidants, causes a variety of health effects which are aggravated by exercise. Ozone also has an increased effect on respiratory functions in the presence of sulfur dioxide.

Nitrogen Dioxide -- Oxides of nitrogen usually originate in high-temperature combustion processes, such as in auto engines and electrical power generating plants.

Although measurement of this pollutant in the atmosphere is difficult, experience has shown that in various forms, oxides of nitrogen can affect humans as well as materials and vegetation. Based on occupational exposures to nitrogen dioxide by firemen, welders, silo fillers, miners, chemists, and other industrial workers, it is known that a high concentration of this pollutant can be fatal to humans. At lower levels of 25 to 100 parts per million, it can cause acute bronchitis and pneumonia. The group of pollutants known as nitrogen oxides also can affect lung tissue and lower the resistance of laboratory test animals to influenza. Scientists suspect the same effect may occur in humans. In one study of school children living near an industrial plant producing nitrogen dioxide, an increase in respiratory disease was noted.

Oxides of nitrogen (NO_x) also can react with hydrocarbons in the presence of sunlight to form photochemical oxidants, which, as noted elsewhere, can affect human lungs and eyes, as well as cause respiratory irritation.

Total Suspended Particulates -- Total suspended particulates (TSP) is a term for the measurement of all particles in the air, including soot, mists, and sprays. TSP includes a wide range of non-toxic materials such as dust and dirt, and many other materials that are known or suspected to be toxic, such as beryllium, lead, asbestos, certain hydrocarbons which may be carcinogenic, suspended sulfates and nitrates, and possible radioactive elements.

The amount of toxic materials in the air will vary geographically, depending on the man-made and natural sources in a particular area. To date, few studies have been conducted on the health effects of individual particles because of the wide range of differences in the makeup of particulate concentrations. Particulate matter is studied for the most part as a single contaminant, and most studies relate particulate concentrations to death, respiratory illness, and breathing problems in urban industrial areas where energy supplied by fossil fuel consumption is a major concern.

The effects of particulate air pollution on health are related to injury of respiratory system surfaces, such as the linings of the lungs and throat. Such injury may be temporary or permanent; and it may be confined to the surface. However, by weakening resistance to infection, such pollutants may affect the entire body adversely. Chemicals carried into the lungs by particulates, for example, may cause cancer to develop on the lung lining, which then may spread throughout the body and prove fatal. Inhaled lead particulates may cause lead poisoning - manifested by nervous and blood symptoms - while causing very little damage to the lung itself.

In studies of air pollution in London and New York City, a rise in the number of deaths has been recorded when both smoke and sulfur oxides levels are high. Studies in Buffalo and Nashville also showed increased death rates, particularly among older persons, where combined pollution from particulates and sulfur oxides were recorded. Eye irritation from dust particles also can be a problem in many areas.

Effects of Air Pollutants on Crops --

The effects of air pollutants on crops have been subject to investigation for nearly thirty years. However, the state of knowledge is not as complete as it is for effects on people. Pollutants can damage crops by stunting growth and by causing physical changes of a type similar to those caused by pests and plant diseases. The stunting of growth reduces the yield per unit area and the visible damage reduces the marketability, particularly for crops destined for supermarket shelves.

The air pollutants of national interest are oxidants, sulfur dioxide, and fluorine compounds. The last two pollutants are characteristic of certain types of point sources and are not of concern at this time in the Denver region. Oxidants, primarily ozone, are the pollutants of primary concern in the Denver region. Crop damage caused by ozone is not a straightforward function of ozone concentration. The degree and type of damage depends on the crop as well as climate. Different varieties of crops, e.g. different hybrids of corn, have varying sensitivities to ozone. Of two varieties of corn exposed 50 percent of the time to oxidant concentrations of 8 parts per hundred million (pphm) or more during daylight hours, one was found to have little significant damage, while the other variety had significant reductions in the number and size of ears produced (Reference 933). The crops most sensitive to oxidants are alfalfa, barley, beans, clover, hay, oats, potatoes, rye, soybeans, sugarbeets, all types of citrus, and leafy vegetables. As many of these crops are grown in the Denver region, air pollutant effects on agricultural productivity are of potential significance.

Existing Air Quality --

Since 1974, the Colorado Department of Health has had six continuous monitoring stations in operation in the Denver area. The locations of these monitoring stations are shown in Figure II-A.

Carbon Monoxide -- Figure II-B shows the number of days that CO standards were violated in 1974 at these monitoring stations. The CAMP station is in the heart of Denver, whereas the Welby Station is in a very rural location.

The winter season is the worst for CO because the inversion heights are lower and the CO is trapped in a more concentrated form. Figure II-C shows the annual trend in 8 hour CO violations for 1974.

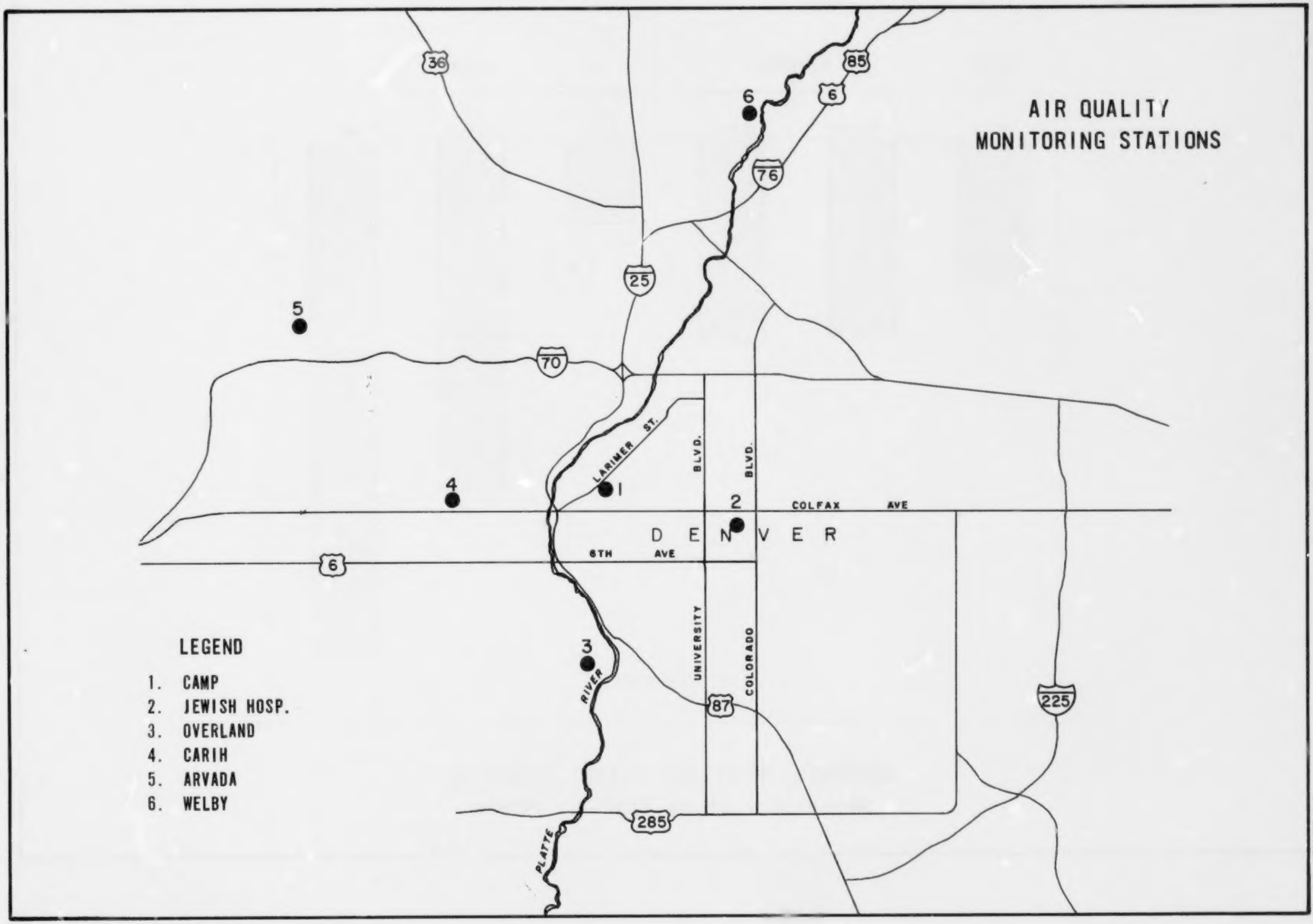
During an average day, CO concentrations tend to peak during the traffic rush hours in the morning and afternoon. Figure II-D demonstrates a typical "CO day" at the downtown CAMP station. Since CO is directly emitted from car exhausts (the principal source of CO in the Denver region is the automobile) concentrations are highest along major streets and busy intersections. These areas of high CO concentrations are often referred to as "hot spots".

Ozone -- Ozone is not directly emitted by pollutant sources, but is formed from hydrocarbon and NO_x emissions by the action of sunlight. Since time is required for the ozone to form, it occurs in the highest concentrations downwind from the hydrocarbons sources, as shown in Figure II-E.

About 80 percent of the hydrocarbon emissions in Denver come from motor vehicles, and about 30 percent of the hydrocarbons come from stationary sources like petroleum refineries, gas stations, and dry cleaners.

Unlike CO, ozone, because of the way it is formed, tends to record highest values in the suburbs. This occurs because during days when wind speeds are low, the hydrocarbons and oxides of nitrogen will have formed ozone about the time the pollutant cloud has drifted over the suburbs and into rural areas. This trend is shown in Figure II-F. In 1974 every monitoring station had a significant number of days when the ozone standard was exceeded.

FIGURE II-A



AIR QUALITY MONITORING STATIONS

LEGEND
1. CAMP
2. JEWISH HOSP.
3. OVERLAND
4. CARIH
5. ARVADA
6. WELBY
1
2
3
4
5
6
D E N V E R
COLFAX AVE
6TH AVE
LARIMER ST.
BLVD.
BLVD.
UNIVERSITY
COLORADO
PLATTE RIVER
36
85
6
76
25
70
6
87
225
285

FIGURE II-B

NUMBER OF DAYS IN 1974 STATIONS
RECORDED LEVELS EXCEEDING STANDARD

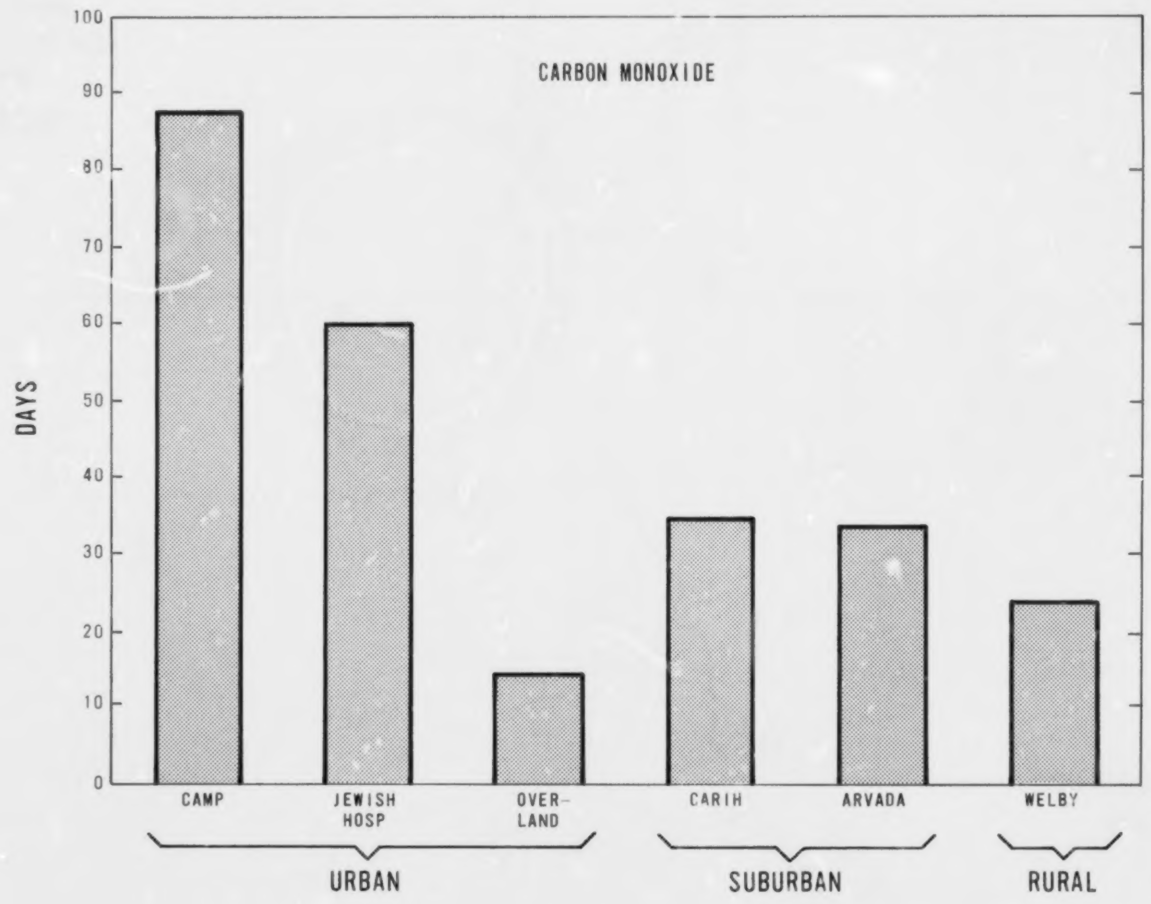


FIGURE II-C

DAYS CARBON MONOXIDE EXCEEDED STANDARD

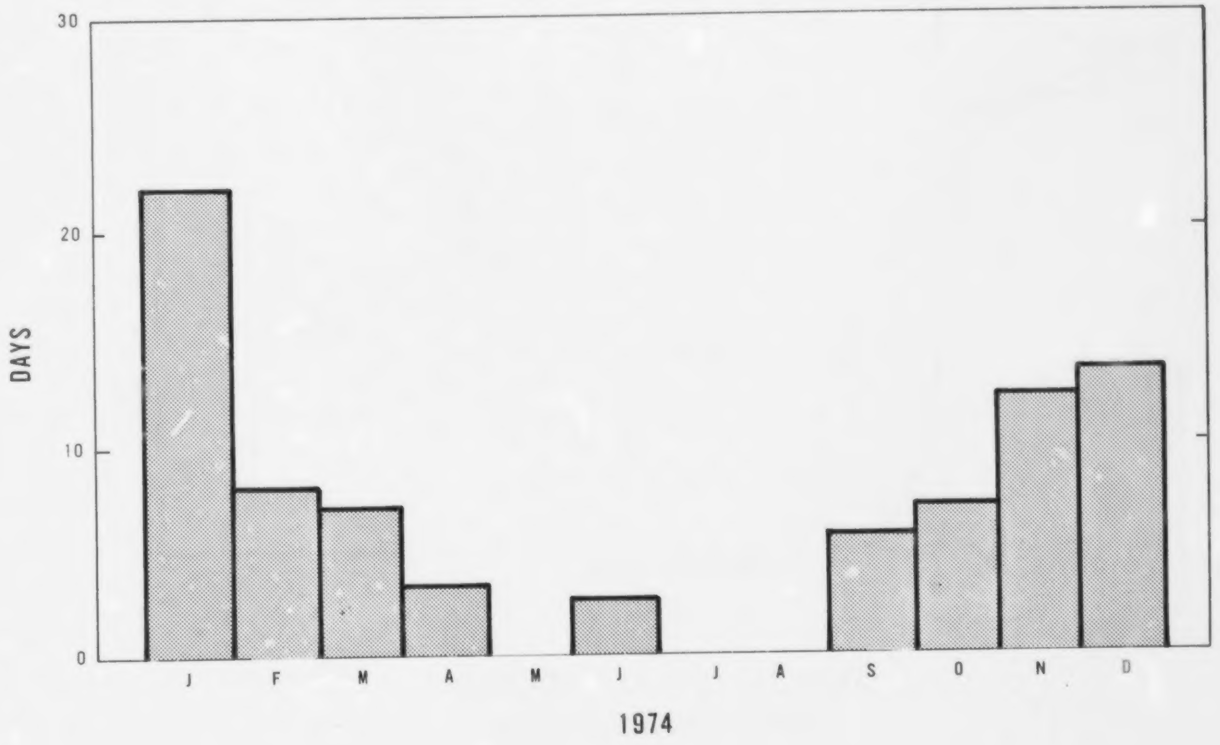


FIGURE II-D

CARBON MONOXIDE LEVELS
COMPARED WITH TRAFFIC VOLUME

CAMP STATION

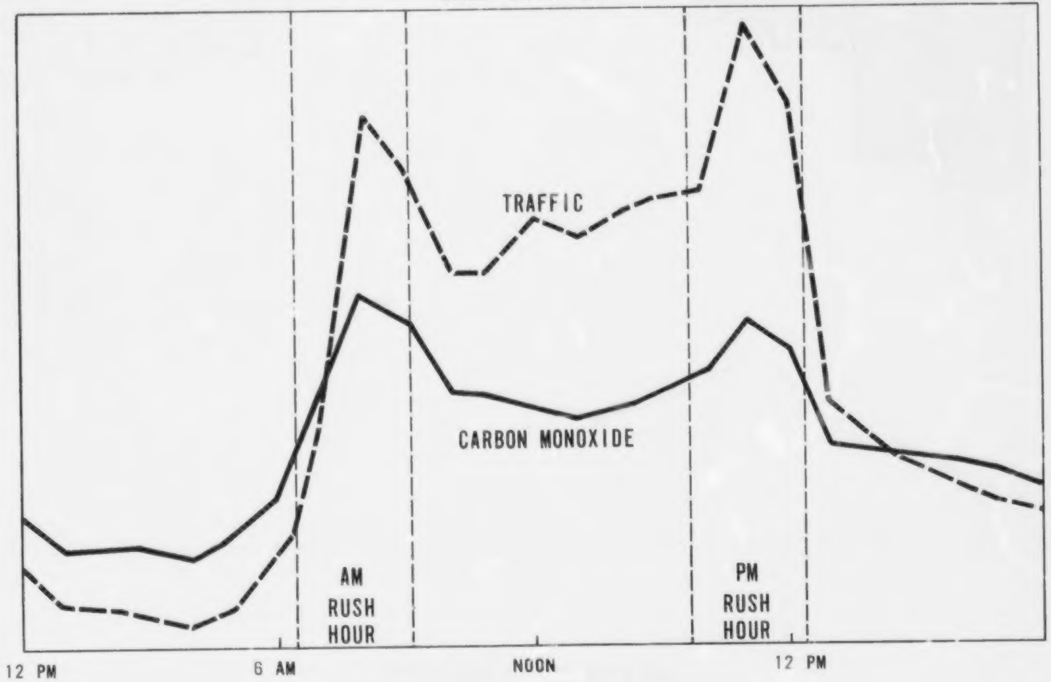
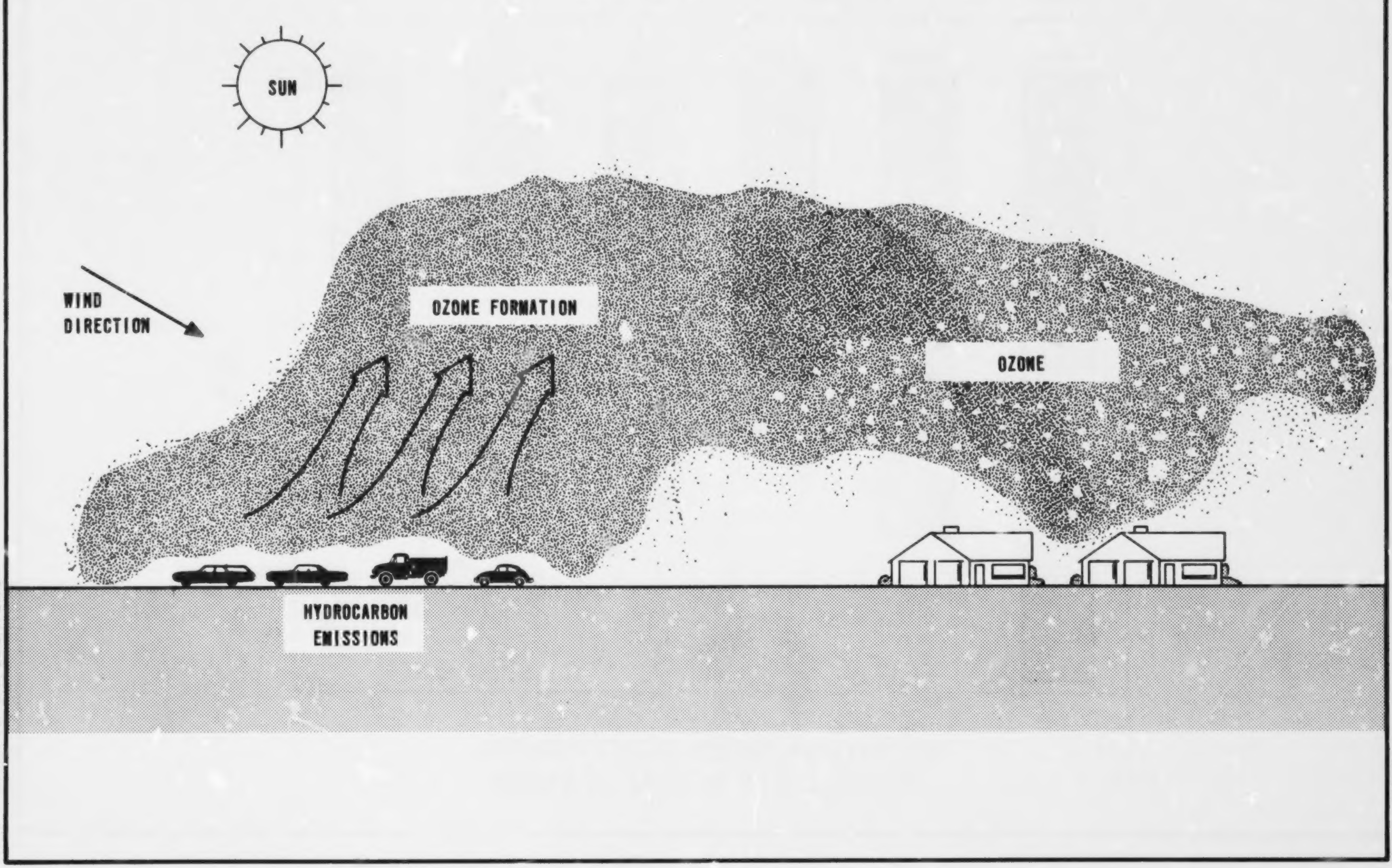
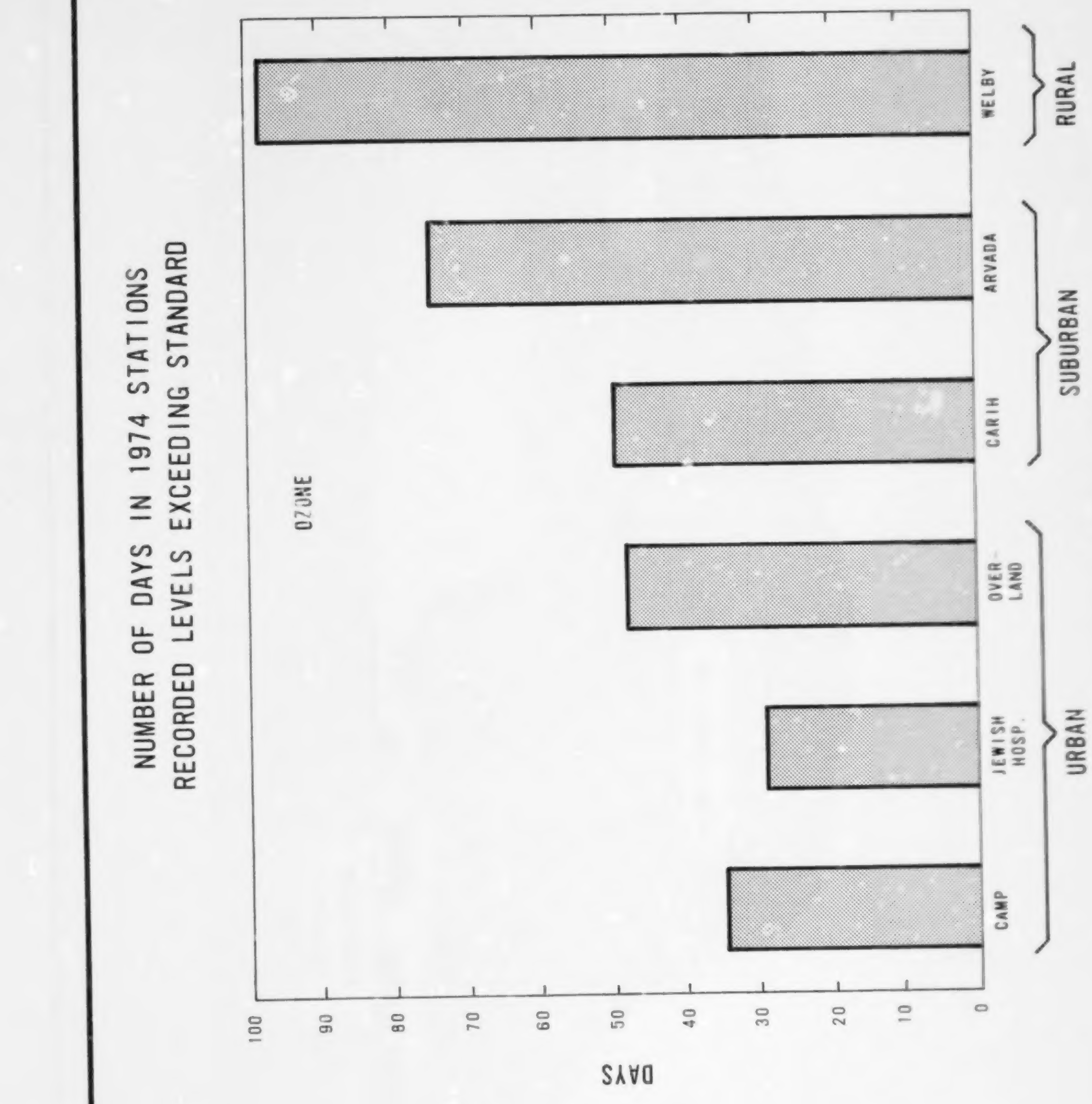


FIGURE II-E

OZONE FORMATION


SUN
WIND DIRECTION
OZONE FORMATION
OZONE
HYDROCARBON EMISSIONS



NUMBER OF DAYS IN 1974 STATIONS RECORDED LEVELS EXCEEDING STANDARD

Ozone tends to be a problem in the summer because larger quantities of ultraviolet radiation from more intense sunlight causes more ozone to be formed. Figure II-G shows this summertime peak in ozone. This characteristic is in direct contrast with the annual distribution of CO concentrations shown in Figure II-C.

Particulates -- Particulate matter is defined as any material, except water, that exists in a finely divided form as a liquid or solid. Since Denver lies in an arid section of Colorado, much of the the particulate matter is generated from unpaved roads, construction operations and natural soil erosion.

Particulate levels in the Denver area also exceed the standards regularly. Fourteen of the twenty-two existing particulate monitors in Denver currently record violation of the ambiant annual particulate standard. Depending on the location, these levels varied from slightly over the standard to almost double the standard in 1974.

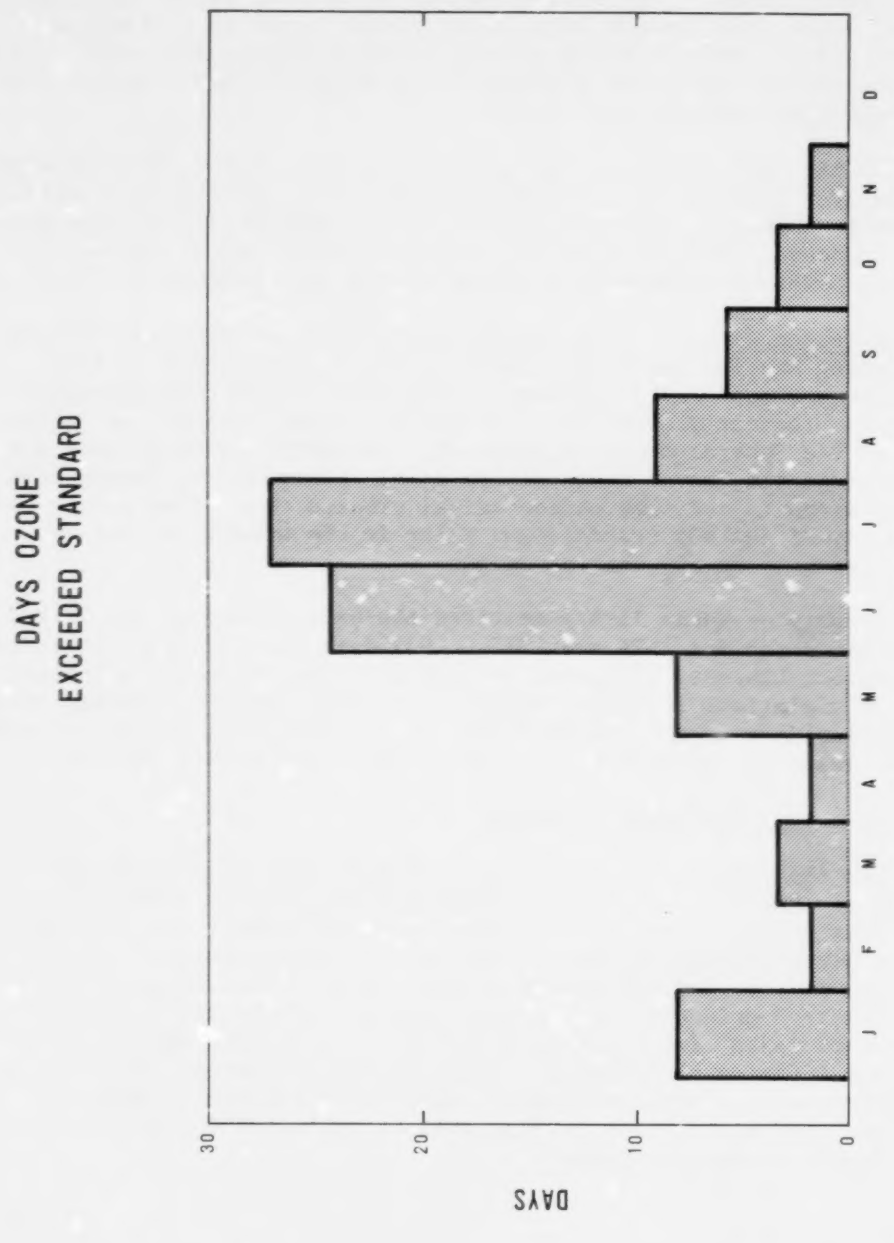
Nitrogen Dioxide -- The Denver region has one nitrogen dioxide monitoring station which is located in the central downtown area where NO sources are the densest. Even with all the photochemical activity frequently experienced during the summer months, no violation of the Federal annual average NO_2 concentration (0.05 ppm) was reported in the Denver Metropolitan Area. Since NO_2 is formed from NO emissions in the same photochemical process that forms ozone, exceedances of the NO_2 standard may exist in the suburbs of Denver were presently no NO_2 monitor exists.

Summary -- Table II-B summarizes the exceedances of the CO and ozone standards for 1974 and 1975. 1974 data was used for the above discussion, however, 1975 data is similar. The frequency and magnitude of violations decreased somewhat in 1975, however, average wind speed also decreased. The decreases in air pollution are not thought to be caused by any reduction in emissions between 1974 and 1975.

Pollutant Emissions in Denver --

For the purposes of evaluating and modeling the present and future air quality in the Denver Metropolitan Area, a number of emissions inventories have been developed for present and estimated future air pollutant emissions, including carbon monoxide, particulates, oxides of nitrogen and hydrocarbons. These inventories were compiled primarily by the staff members of the Air Pollution Control Division of the Colorado Department of Health and by the Colorado Division of Highways. A discussion of current emissions is presented next. Future emissions, which are utilized to predict 1985 and 2000 air quality levels, will be discussed in the Probable Environmental Impacts Chapter.

FIGURE II-G



DAYS OZONE
EXCEEDED STANDARD

Table II-B. MAXIMUM POLLUTION CONCENTRATIONS MEASURED DURING 1974 AND 1975 IN DENVER

	One-hour CO[a]						Eight-hour CO[b]						One-hour O_3[c]					
	Days with violations, %		2nd max PPM		Max PPM		Days with violations, %		2nd max PPM		Max PPM		Days with violations, %		2nd max PPM		Max PPM	
Sample	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975	1974	1975
CAMP	2	2	61	46.1	70	47.2	29	21	28.9	22.3	30.3	22.6	9	5	.180	.115	.185	.132
Nat. Jewish	2	2	49	43.1	59	51.4	17	19	19.1	23.1	19.7	24.0	9	4	.140	.108	.155	.110
Arvada	0		28	23.5	32	26.9	8	3	15.2	14.0	17.0	16.0	21	22	.170	.178	.220	.197
CARIH	0		26	27.3	27	27.9	10	8	14.8	21.9	18.6	23.3	14	17	.140	.135	.155	.139
Overland	0		25	22.5	30	28.8	4	2	11.7	12.0	14.6	15.0	15	13	.165	.135	.165	.139
Welby	0		22	27.5	24	30.8	6	4	13.5	16.6	16.3	19.0	36	18	.250	.177	.375	.182

[a] One-hour CO standard = 35 PPM

[b] Eight-hour CO standard = 9 PPM

[c] One-hour O_3 standard = .08 PPM

Source: JRPP Air Quality Assessment Statement, Colorado Division of Highways, 1 November 1976.

The air pollutant emissions that constitute the main problem in the Denver Metropolitan Area are carbon monoxide, particulates, reactive hydrocarbons (which react to form ozone) and the oxides of nitrogen. Automobile traffic accounts for a major fraction of the pollutants emitted. All traffic accounts for roughly 80 percent of the hydrocarbon emissions, 30 to 40 percent of the nitrogen oxide emissions, and about 95 percent of the carbon monoxide emissions. It is thought that, while automobiles and other vehicles do not directly contribute a high proportion of the particulate emissions in the Denver Metropolitan Area, street sanding operations, which are related to the operation of these vehicles, contribute anywhere from 45 to 60 percent of the total particulate emissions. Next to automobiles and other traffic, point sources are the most significant contributors to total emissions. Large point emissions alone account for as much as 50 percent of the total emissions of the oxides of nitrogen. Table II-C gives the Denver emissions inventory estimated for 1974. The State Air Pollution Control Division is currently revising the Denver emissions inventory to incorporate the latest estimates of vehicle emissions, current transportation planning and population distribution forecasts.

Geology

The Denver area is divided into two distinct bedrock regions, both of which dip to the east. The slightly dipping strata of the plains is separated from the steeply dipping strata of the Front Range, by a north-northwest, south-southwest trending zone of sharp, almost vertical folds. The locations of unique and significant geological structures and formations are shown on Map C.

The most important potential geologic problem in the Denver area is the shrink-swell characteristics of bentonitic clays found in the Denver-Arapahoe and other formations underlying most of the clay-derived soils in the area. Shrink-swell potential, which can place severe restrictions on urban development because of slippage and differential settling risks, is greatest in the foothills west of Denver where special site design is needed. This potential is moderate-to-low elsewhere in the region. Other less widespread geologic hazards include landslides in the western foothills having slopes greater than 25 percent and soils supported by clay substrata; subsidence and slope instability in mining areas found scattered on the north, west, and south peripheries of the metropolitan area; and faults (see Map C) representing a very low potential for seismic activity in the region.

Table II-C 1974 DENVER EMISSIONS INVENTORY

Source	Emissions, tons	Contributions, %
Carbon monoxide[a]	(per day)	
Automotive	2,925.0	94.5
Space heat	2.9	0.1
Point sources	167.6	5.4
Total	3,095.5	100.0
Hydrocarbons[b]	(per day)	
Automotive	199.18	83.9
Space heat	0.48	0.2
Oil paint	2.08	0.9
Gas stations	11.67	4.9
Cleaners	4.94	2.1
Incinerators	0.11	0.0
Point sources	13.14	5.5
Airports	5.92	2.5
Total	237.52	100.0
Particulate	(per year)	
Space heat	511	1.4
Automotive	4,213	11.9
Airports	63	0.0
Construction	8,730	24.7
Street sanding	15,857	44.9
Point sources	5,981	16.7
Total	35,355	99.6
NO_2	(per year)	
Space heat	5,348	7.4
Small points	87	0.0
Automotive	31,646	43.7
Airports	1,552	2.1
Point sources	33,773	46.6
Total	72,406	99.8

[a] Based on winter emissions distributions.

[b] Based on summer emissions distributions.

Soils

Soils in the study area have been surveyed by the U.S. Soil Conservation Service (SCS) in recent years. Final survey reports have been published for Adams and Arapahoe Counties (Reference 701 and 702), while the results of the other county soil surveys for the study area have yet to be published.

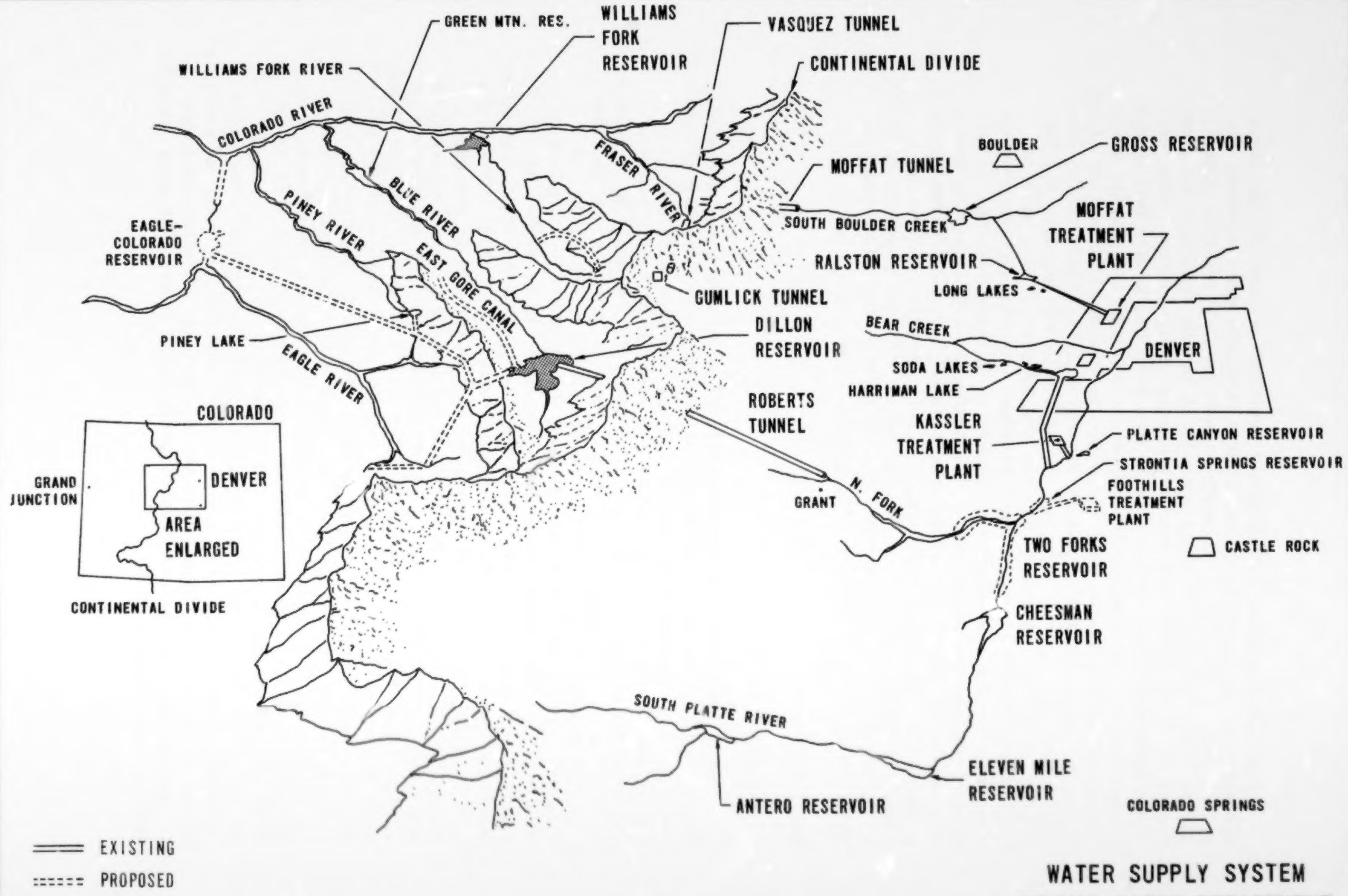
Because considerations of the agricultural capabilities of the regional soils will be discussed at length under "Agricultural Land Use", this discussion will address only general soil-related problems. The major problem of most soils in the region is the shrink-swell characteristics discussed in Geology above. The other significant regional soils problem is aeolian, i.e. wind, erosion. Where dryland farming is practical, wind erosion causes losses of valuable topsoil during severe windstorm episodes. This problem is especially critical in the dryland farming areas of Adams and Arapahoe Counties.

Hydrology

The principal hydrologic system is the South Platte River and its tributaries. The South Platte River and the tributaries of Bear Creek, Clear Creek, Boulder Creek and Coal Creek have their headwaters in the mountains to the west (see Map E). They are snowmelt streams whose annual variation of flow is directly related to the snow pack accumulated during the previous winter. Approximately 75 percent of the annual flow occurs during the spring and early part of the summer, peaking in May or June. The remaining 25 percent of the flow occurs during the fall and winter months, with the low flow in January or February. The other major tributaries, including Cherry Creek, Sand Creek, Big Dry Creek and Plum Creek, rise on the plains east of the mountains. Flow of these streams comes principally from precipitation. All streams in the study area respond vigorously to frontal and thunderstorm rainfall events.

The natural flow of the South Platte River is insufficient to meet the total demand of municipal, industrial and agricultural users. This has lead to an elaborate regulation and distribution system consisting of diversions for irrigation, transmountain diversions to augment basin supplies, and numerous reservoirs for irrigation and flood control (see Figure II-H). This system of water use, reuse and subsequent use radically alters the natural flow characteristics of many streams. Flows in Cherry Creek below Cherry Creek dam are sometimes comprised entirely of urban runoff. At times, the flow in Clear Creek below Golden is primarily from sewage treatment plant effluent, and at other times it is dry due to irrigation diversions. Sand Creek is frequently an intermittent stream with periods of no flow. Normal flows in Big Dry Creek are primarily irrigation and irrigation return flows in addition to urban runoff.

FIGURE II-H


GREEN MTN. RES.
WILLIAMS FORK RESERVOIR
VASQUEZ TUNNEL
CONTINENTAL DIVIDE
WILLIAMS FORK RIVER
COLORADO RIVER
FRASER RIVER
BOULDER
GROSS RESERVOIR
MOFFAT TUNNEL
MOFFAT TREATMENT PLANT
SOUTH BOULDER CREEK
EAGLE-COLORADO RESERVOIR
PINEY RIVER
BLUE RIVER
EAST GORE CANAL
RALSTON RESERVOIR
CUMLICK TUNNEL
LONG LAKES
DILLON RESERVOIR
BEAR CREEK
PINEY LAKE
EAGLE RIVER
DENVER
SODA LAKES
HARRIMAN LAKE
ROBERTS TUNNEL
COLORADO
KASSLER TREATMENT PLANT
PLATTE CANYON RESERVOIR
GRAND JUNCTION
DENVER
AREA ENLARGED
STRONTIA SPRINGS RESERVOIR
FOOTHILLS TREATMENT PLANT
GRANT
N. FORK
TWO FORKS RESERVOIR
CASTLE ROCK
CONTINENTAL DIVIDE
CHEESMAN RESERVOIR
SOUTH PLATTE RIVER
ELEVEN MILE RESERVOIR
ANTERO RESERVOIR
COLORADO SPRINGS
EXISTING
PROPOSED

SOURCE: RTD

WATER SUPPLY SYSTEM
DENVER WATER DEPARTMENT

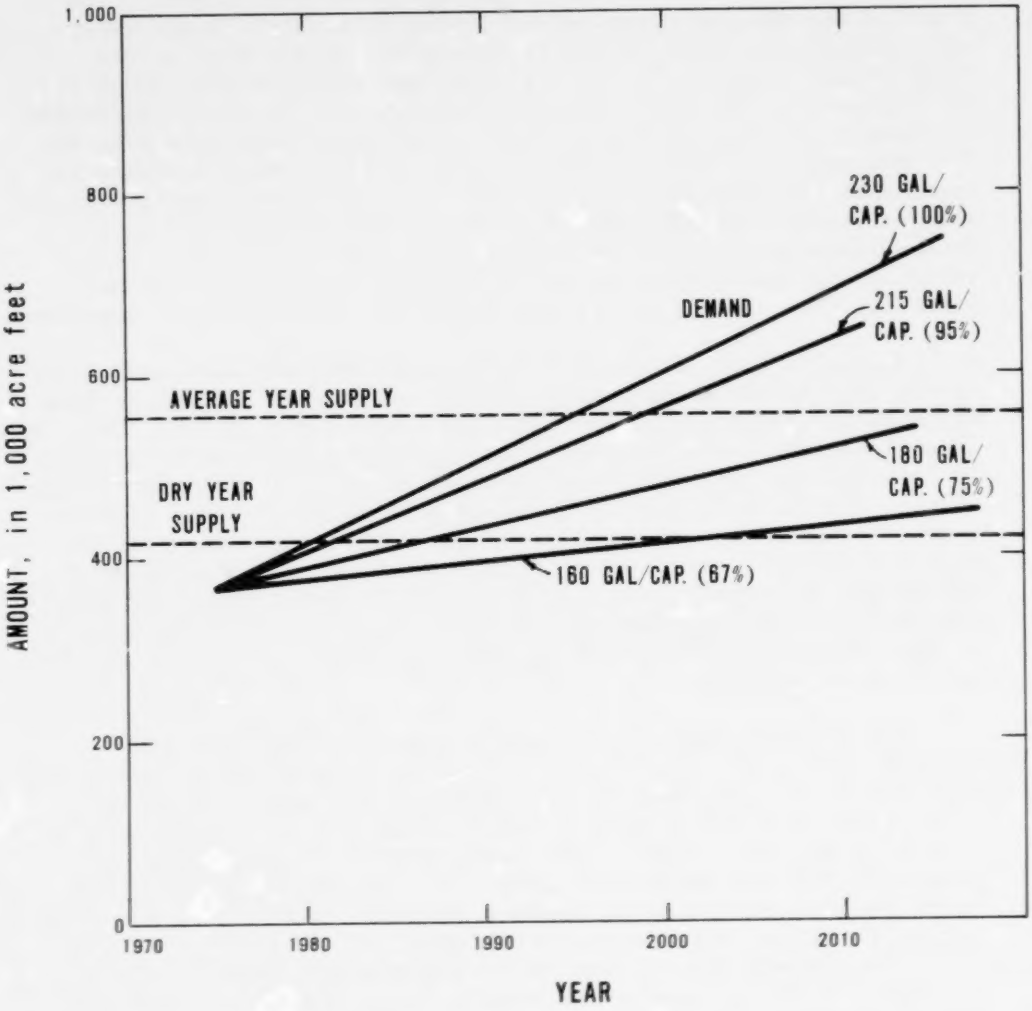
Past urbanization has severely constricted some of the drainage ways to the point where structural measures are necessary to safely pass a 100 year flood without substantial property damage. Severe structural flood control projects in the area have been conducted up to at least the master planning design state. They include Chatfield Damn, Cherry Creek Dam, Bear Creek Lake Dam (under construction), and channel improvements for Sanderson Gulch, which are designed for the 10 year flood event. Regulations are in effect to limit the peak rate of runoff from urbanizing lands to the historic peak rate in the counties of Jefferson and Boulder, and the Cities of Arvada, Lakewood, Boulder and Thornton. The basin or regionwide effect of requiring individual developments to provide detention to meet historic peak runoff requirements is yet to be determined for the study area. The aggregate effect may be higher peak rates of runoff for downstream reaches because detained hydrographs from individual subbasins are long and flat and are more likely to become additive. Present major drainage planning is based on future basin development and considers that detention requirements will not be effective (see Map G).

Water Supply

Surface Water --

The largest municipal water supplier is Denver Water Department which provides the City and County of Denver, plus a number of suburban cities, special districts and other agencies with approximately two-thirds of the municipal raw water used in the region. Thirty-three percent of the raw water utilized for municipal purposes in the region is transmountain water imported from west of the Continental Divide by the cities of Denver, Aurora, Englewood, and Boulder. Data from the Bureau of Land Management's EIS (Reference 615) and from the Denver Water Department's 1975 study of future water demand (Reference 1001) were used in developing the information shown in Figure II-I. The projection, based upon a 0.87 cubic metre (230 gallons) per capita per day rate of consumption is the rate in reference 615 applied to the region's population. Other projections are based on consumption rates incorporating feasible management and conservation practices. Reference 615 states that by 1980, the Denver Water Department's ability to meet demand, about two-thirds of the region's demand, will be constrained by the available capacity for water treatment if the proposed Foothills water treatment project is not built. This constraint occurs during summer peak demand days. The quantity of raw water available to Denver will constrain demand by 1988 without Foothills and by 1990 if Foothills is built. Thus, according to the EIS on the Foothills project, additional raw water supplies, probably additional west slope importations, will be needed in either event if past consumption rates continue. Conservation and management practices could significantly delay these treatment capacity and raw water supply needs.

DENVER REGION WATER SUPPLY AND DEMAND



NOTE: POPULATION IS 2,350,000
FOR THE YEAR 2000.

Ground Water --

There are two ground-water systems in the Denver area. The first is the shallow ground-water system of aquifers under water-table conditions found in the flood plains and terraces of the South Platte River basin, in the dune sand deposits that occur in the vicinity of the Rocky Mountain Arsenal, and in the alluvial fan remnants that occur adjacent to the Front Range Mountains (See Map C). Recharge to these aquifers occurs in areas where deposits are exposed to the land surface. Further onto the plains area, streams receive ground water discharges from shallow ground-water aquifers. These discharges account for much of the flow in the South Platte basin during the latter part of the summer. The shallow ground-water aquifers in this area are sources for domestic water supplies.

Unusually high levels of nitrite have recently been discovered in the City of Thronton's water system, which gets its supply from wells in the alluvial aquifer near the South Platte River. This is unusual because nitrite is unstable and easily oxidized to nitrate. It is suspected that the recent drought has caused the overdrafting of the alluvial aquifers. This would accelerate recharge from the South Platte River which contains high levels of nitrates due in part to nitrate concentrations in the discharge from the MDSDD #1 wastewater treatment plant. This hypothesis has not been proved, and by itself does not explain high levels of nitrite. However, it does demonstrate that surface water quality can affect a public ground-water supply.

The second system is the deep ground-water aquifers under artesian pressure. These aquifers are the Dawson, Denver and Arapahoe formations, and the Laramie-Fox Hills sands containing water under pressure at depths ranging from 150 to 900 metres (500 to 3,000 feet) beneath the Denver region. These units are separated from one another by layers of clay and shale which minimizes the movement of water between aquifers. Generally, recharge occurs throughout the southwestern quarter of the study area and along the western edge of the Denver basin where these aquifers outcrop. There are some wells drawing water from the Laramie-Fox Hills formation. The water from some of these wells contain concentrations of iron and fluoride above limits recommended for a public water supply.

Water Quality

The following discussions of current water quality in the Denver region are based in large part on information developed by DRCOG and its consultants to support the preparation of the Denver Clean Water Plan (CWP). This program is frequently or commonly termed the 208 Plan because it is required by Section 208 of the Water Pollution Control Act Amendments of 1972.

A number of physical parameters, chemical and biological are used to indicate water quality. These characteristics are important because they either directly affect people and wildlife or indirectly interact to cause effects. For example, certain amounts of dissolved oxygen (DO) in the water are necessary to support fish life and other desirable organisms. Water temperature (T) affects the amount of dissolved oxygen water can contain. Biochemical oxygen demand (BOD) refers to the amount of organic material which is available as food for various organisms. When a large amount of food is available, the number of organisms increases and the amount of oxygen in the water is reduced. The term BOD_5 is commonly used to indicate the BOD over a five day period. Total dissolved solids (TDS) are in the form of salts. High TDS in water for agriculture limits crop productivity and can cause salts to build up in soils and permanently degrade agricultural soils. High TDS mades water disagreeable to taste and can cause effects such as diarrhea. It also limits the use of water by industry in manufacturing processes. Ammonia (NH_3) is toxic to fish. Nitrates (NO_3) can cause serious health problems for infants if nitrates get into a public water supply. Nitrogen and phosphorus compounds (NO_3, PO_4) supply nitrients to small water-borne plantlike organisms. Algal blooms may occur and cause unpleasant odors and unsighliness. Also, when these organisms die and decay, they represent a BOD. Fecal coliforms and streptococci (colistrep) are bacteria naturally occurring in the intestines of humans and warmblooded animals. The presence of these bacteria are used as indicators of fecal contamination of water, and thus the possible presence of disease causing bacteria.

Desired Water Quality --

During the Clean Water Program study, various water uses were considered and evaluated for the study area. Four broad areas of desirable uses were identified: agriculture (irrigation and livestock watering), recreation (primary and secondary contact), maintenance of aquatic life (cold and warm water fisheries and stream or lake aesthetics), and domestic raw water supply.

Current stream classifications and the recommended stream quality parameter values for these uses are indicated in Table II-D. Table II-E indicates the current State classification by reach of the streams in the study area. Map E will assist the reader in identifying streams.

Table II-F presents the historical and present uses, present State stream classification; and the Clean Water Plan (CWP) use classification recommendations for the major streams in the study area.

Table II-D. RECOMMENDED WATER QUALITY LEVELS FOR SPECIFIC WATER USES

Stream classification	Uses	Water quality parameters/limits									
		Temperature, °C	Dissolved oxygen, mg/1	BOD_5, mg/1	Total dissolved solids, mg/1	Fecal coliforms, MPN/100 ml	Fecal streptococci, MPN/100 ml	NH_3-N, mg/1	NO_3-N, mg/1	Total N, mg/1	PO_4-P,* mg/1
B_2	Aesthetics (stream), wildlife and livestock watering, urban irrigation, secondary contact recreation, warm water fishery	8 to 30	5	–	1,000 to 3,000	200 to 1,000	20	2.5	10	10	0.05
B_1	Same as above (B_1) except cold water fishery	5 to 15	6	–	1,000 to 3,000	200 to 1,000	20	1.0	10	10	0.05
A_2	Aesthetics (stream or lake), wildlife and livestock watering, urban irrigation, primary contact recreation, domestic potable water (raw supply), warm water fishery, plus all B_2 uses	8 to 30	5	–	500	200	20	2.5	10	10	0.025 to 0.1
A_1	Same as above (A_2) except as cold water fishery, plus all B_1 uses	5 to 15	6	–	500	200	20	2.5	10	10	0.025 to 0.1

---

[*] Phosphates are essential for biological growth especially algae, but other conditions must exist before problems result. Recommended levels indicate a significant photential problem may exist if other necessary conditions exist.

Source: Engineering Science based in large part on References 208, 228, 263 and standards proposed by Colorado Department of Health.

Table II-E. CURRENT STATE OF COLORADO
CLASSIFICATION BY STREAM AND REACH

Stream	Use class	Reach
South Platte	B_1	Source to Exposition Avenue
South Platte	B_2	Exposition Avenue to Nebraska
Sloans Lake	A_2	Inlet to outlet
Bear Creek	B_1	Source to Morrison
Bear Creek	B_2	Morrison to South Platte
Cherry Creek Reservoir	A_2*	Inlet to outlet
Cherry Creek	A_2*	Source to reservoir
Cherry Creek	B_2	Reservoir to South Platte
Clear Creek	B_1	Source to Farmers Highline Canal
Clear Creek	B_2	Farmers Highline Canal to South Platte
Coal Creek	B_1	Source to Highway 93
Coal Creek	B_2	Highway 93 to mouth
South Boulder Creek	B_1	Source to Highway 93
South Boulder Creek	B_2	Highway 93 to mouth
Boulder Creek	B_1	Source to Highway 119
Boulder Creek	B_2	Highway 119 to mouth
Sand Creek	B_2*	Source to South Platte
Big Dry Creek	B_2*	Source to South Platte

*Initially assumed for 208 study; not State of Colorado classification.
Source: Reference 228

Table II-F. WATER QUALITY ATTAINABILITY/USE POTENTIAL

208 Basin	Historical and present use	Present State classification	Use potential	CWP Re[illegible]ended Use
Upper South Platte	Natural trout stream formerly Cold-water put-and-take fishery at present to Chatfield Reservoir Swimming, rafting during high flows	B_1 Cold-water fishery	Natural cold-water fishery with suitable substrate and flow conditions Swimming, rafting	Primary-contact recreation Agriculture and wildlife Cold-water fishery Water supply
South Metro	Natural trout stream formerly	B_1 Cold-water fishery (to Exposition Avenue)	Rafting, boating Cold-water fishery, put-and-take	Primary-contact recreation Agriculture and wildlife Cold-water fishery Water supply
Lower South Platte through Lakewood Basin	Only rough fish in flowing waters or pooled areas Some waterfowl use and some boating	B_2 Warm-water fishery (from Exposition Avenue)	Boating Warm-water fishery	Secondary-contact recreation Wildlife Agricultural/industrial use
Lower South Platte through Clear Creek Basin	Only rough fish in flowing waters/or pooled areas Some waterfowl	B_2 Warm-water fishery (from Exposition Avenue)	Boating Warm-water fishery	Secondary-contact recreation Agricultural/industrial use
Lower South Platte below 104th Avenue	Only rough fish in flowing waters or pooled areas Boating during high flows	B_2 Warm-water fishery	Warm-water fishery with increased flows and improved quality Boating, rafting	Secondary-contact recreation Agricultural/industrial use
Cherry Creek above reservoir	Rough fish Rafting in Highline Canal during high flows	Unclassified (A_2 reservoir)	Warm-water fishery	Primary-contact recreation Agricultural/industrial use Warm-water fishery Water supply
Cherry Creek below reservoir	Rough fish and some warm-water fish when flows consistent Boating in downstream areas	Unclassified	Potential for secondary-contact recreation in downstream areas Warm-water fishery in downstream areas, upstream with flow releases Boating	Secondary-contact recreation Groundwater supply Wildlife Agricultural/industrial use

Table II-F. WATER QUALITY ATTAINABILITY/USE POTENTIAL (continued)

208 Basin	Historical and present use	Present State classification	Use potential	CWP Recommended Use
Sand Creek	Rough fish in pooled areas most of the year No recreation	Unclassified	Recreational potential during high flows No fishery potential, only rough fish	Secondary-contact recreation Wildlife Agricultural/industrial use
Bear Creek through Morrison	Natural trout fishery to Morrison formerly Put-and-take fishery at present	B_1 Cold-water fishery (to Morrison)	No recreation potential in upstream area Natural cold-water fishery potential	Cold-water fishery Primary-contact recreation Wildlife Water supply Agricultural/industrial use
Bear Creek below Morrison	Some put-and-take fishery at present Rafting, boating downstream from Morrison	B_2 Warm-water fishery (from Morrison)	Recreation potential for rafting, boating Potential for cold-water fishery with releases from Mr. Carbon Reservoir	Primary-contact recreation Water supply Wildlife Cold-water fishery Agricultural/industrial
Clear Creek to Golden	Natural cold-water fishery formerly Natural cold-water fishery to Idaho Springs Fish populations precluded from Idaho Springs to Golden from low pH values, heavy metals	B_1 Cold-water fishery (to Highline Canal)	Natural cold-water fishery to Golden	Cold-water fishery Water supply Primary-contact recreation Agricultural/Industrial Wildlife
Clear Creek below Golden	Some trout and downstream some warm-water fish species Boating, rafting downstream of Golden	B_2 Warm-water fisheries (Highline Canal downstream)	Rafting, boating Warm-water fishery downstream of Golden	Secondary-contact recreation Water supply Agricultural/Industrial Use
Big Dry Creek upstream of Standley Reservoir	Put-and-take cold-water fishery upstream of Standley Reservoir *	Unclassified	Cold-water fishery	Cold-water fishery Water supply Primary-contact recreation
Big Dry Creek below Standley	Rough fish and warm-water fishery	Unclassified	Warm-water fishery with sufficient flows	Warm-water fishery Secondary-contact recreation Wildlife Agricultural/industrial

*U.S. Forest Service Comments that there is no cold-water fishery in this area.

II-F. WATER QUALITY ATTAINABILITY/USE POTENTIAL (continued)

208 Basin	Historical and present use	Present State classification	Use potential	CWP Recommended Use
Coal Creek to intersection with Route 93	Natural cold-water fishery upstream formerly Put-and-take at present	B_1 Cold-water fishery	Cold-water fishery	Cold-water fishery Primary-contact recreation Wildlife Agricultural/industrial Water supply
Coal Creek Route 93 to South Platte	Rough fish and warm-water fishery	B_2 Warm-water fishery	Warm-water fishery	Secondary-contact recreation Wildlife Agricultural/industrial Groundwater supply
Boulder Creek source to 75th Street	Natural cold-water fishery	A_1 Domestic use, primary/secondary-contact recreation, fisheries	Domestic use, recreation Cold-water fishery	Primary-contact recreation Cold-water fishery Water supply Agricultural/industrial
Boulder Creek, 75th Street to Coal Creek	Cold-water put-and-take fishery Rafting, swimming	B_1 Cold-water fishery	Primary-contact recreation Cold-water fishery with reservoir releases	Primary-contact recreation Cold-water fishery Water supply Agricultural/industrial
Boulder Creek, Coal Creek to mouth	Cold-water put-and-take fishery and warm-water fishery	B_2 Warm-water fishery	Cold-water fishery with flows, otherwise warm-water fishery	Secondary-contact recreation Agricultural/industrial

Note: Historical and present uses were obtained through existing literature sources and from interviews Resource Planning Associates conducted with state and local experts in fisheries and water quality management and with DRCOG representatives during the week of December 6-10 in the Denver area. State classifications are those made effective June 19, 1974. Use potential is a concensus of opinion of the experts interviewed for this analysis and RPA's professional judgment as to the highest and best uses for these stream segments; use potential responds to the Colorado State Water Quality Control Commission's desire to assign a stream classification for the highest and best use to which a stream segment could be put on the basis of past and present uses and/or natural conditions. Use potential does not consider the technological capability, cost, or socio-economic impact of implementing such a classification. The recommended use is the Clean Water Plan's recommendation for stream classification to meet permits for Denver area streams. The CWP recommendations must be acted on by the Water Quality Commission and EPA prior to adoption.

Source: References 259, 263

It should be recognized that the Clean Water Plan use recommendations represent goals for the study area the Clean Water Plan considers consistent with the national goals of "fishable and swimmable waters" by 1983 and "zero" discharge of pollutants by 1985, as stated in the Federal Water Pollution Control Act Amendments of 1972. The Clean Water Plan recommends downgrading the classification of a number of stream reaches by eliminating fishery designations. The State of Colorado, however, has not adopted these use recommendations nor the quality criteria used in the Clean Water Plan.

Existing Water Quality --

The following subsections present the "existing" water quality in the study area by basin, based on stream data obtained during calendar year 1972. Table II-G is a list of the wastewater treatment facilities that were investigated for their impact upon stream water quality.

Data for 1972 was used largely because this was the year picked by DRCOG for Clean Water Program planning as most representative of flow conditions for the last several years and for which water quality data were available. The data used to characterize water quality in 1972 is summarized in Table II-H. This data is compared with the recommended levels shown in Table II-D and stream classifications shown in Table II-E to evaluate water quality in 1972.

South Platte Basin Water Quality Trends -- The following discussions are based primarily on average levels for various water quality parameters. Effects of runoff events will be discussed after each water quality parameter is examined.

Water temperature, in addition to following normal seasonal trends, generally increases as flow proceeds through the urbanized area of the basin. Temperatures are within limits for the water uses designated for the various streams or portions of streams, except for Bear Creek above Morrison, and the South Platte above Littleton. Temperature limits are sometimes exceeded during late summer.

Dissolved oxygen (DO), also follows expected seasonal trends with DO levels decreasing from winter levels during the course of the year until fall, when water temperatures begin to decrease and DO levels begin to rise. Dissolved oxygen levels decrease as water flows through the Denver area. Average dissolved oxygen levels consistently meet recommended limits for the various water uses.

Total dissolved solids (TDS) show weak seasonal trends, but seem most influenced by flow through the urban area. TDS levels for tributaries to the South Platte generally increase by a factor of

Table II-G. WASTEWATER TREATMENT FACILITIES INVESTIGATED FOR THEIR IMPACT ON EXISTING WATER QUALITY, STATUS CIRCA 1972

Plant	Type	Capacity, mgd Primary	Capacity, mgd Secondary	Receiving Stream
Morrison	Activated sludge rotot aeration	0.07	0.07	Bear Creek
Glendale	Activated sludge	1.0	1.0	Cherry Creek
Aurora	Activated sludge	1.5	1.5	Sand Creek
Fitzsimons	Trickling filter	0.9	0.9	Tollgate Creek
Coors	Activated sludge	4.0	9.0	Clear Creek
Wheatridge	Trickling filter	2.5	2.5	Clear Creek
Clear Creek Valley	Activated sludge	2.1	2.1	Clear Creek
Arvada	Trickling filter	0.7	0.7	Clear Creek
Crestview	Trickling filter	1.0	1.0	Clear Creek
Littleton	Trickling filter activated sludge	7.6	7.6/1.5	South Platte
Englewood	Trickling filter	12.0	12.0	South Platte
South Lakewood	Activated sludge	1.3	1.3	South Platte
Metro Denver #1	Activated sludge	28.0	98.0	South Platte
South Adams County	Trickling filter	2.5	2.5	South Platte
Broomfield	Trickling filter	1.6	1.6	Big Dry Creek
Westminster	Activated sludge	1.0	1.0	Big Dry Creek
Erie	Lagoon	2.57 acres		Coal Creek
Lafayette	Trickling filter	0.3	0.3	Coal Creek
Louisville	Activated sludge aerated lagoon	0.7	0.7	Coal Creek
Boulder White Rocks	Trickling filter	15.6	15.6	Boulder Creek

Table II-H. EXISTING WATER QUALITY
(1972)

Location	State-assigned classification	Temperature, °C		Dissolved oxygen, mg/1		Total dissolved solids, mg/1		BOD, mg/1		Ammonia, mg/1		Nitrate, mg/1		Phosphate, mg/1		Fecal coliforms, MPN/100 ml		Fecal streptococci, MPN/100 ml	
		Avg	Peak	Avg	Min	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak
Winter																			
Bear Creek at Morrison	B_1	6	12	13		90	95	3	4	0.13	-	0.31	-	0.23	-	200	-	300	-
Bear Creek at mouth	B_2	10	17	10.8	7.2	200	3,800	4	42	0.2	1.8	1.0	6	0.3	2	300	15,000	700	154,000
Cherry Creek at Franktown	A_2	2	4	13.6		250	-	2	-	0.01	0.05	0.11	0.15	0.01	-	-	-	-	-
Cherry Creek at mouth	B_2	8	18	10.3	7.3	430	6,800	3	81	1.0	3.5	3.0	5	4	7	650	26,000	1,800	204,000
Sand Creek at mouth	B_2	9	15	11	7.5	900	4,000	9	43	5	7	3	4	3.5	4.5	2,500	19,000	4,000	123,000
Clear Creek at Golden	B_1	4	10	13		200	500	2	5	0.23	-	0.4	-	0.2	-	204	600	300	400
Clear Creek at mouth	B_2	8	20	11	7	400	4,000	18	50	4	11	2.5	4	3.2	5	800	25,000	300	200,000
South Platte at Blakeland	B_1	7	12	9.5		250	-	5	-	0.01	-	0.03	-	0.05	-	30	35	40	45
South Platte at 38th Ave.	B_2	8	15	10.5		500	4,500	14	17	3	3.8	1.5	1.8	2	4.5	600	17,000	20,000	130,000
South Platte at Henderson	B_2	8	16	10.2	7.3	700	4,000	30	33	10	13	1.8	5	5	6.5	1,000	16,000	2,500	125,000
Spring																			
Bear Creek at Morrison	B_1	10	14	9.2		85	100	3	4	0.13	-	0.31	-	0.23	-	400	1,500	300	1,000
Bear Creek at mouth	B_2	20	25	8.5	6	220	3,000	3	32	0.2	0.7	1.5	4.5	0.3	2.3	300	15,000	700	121,000
Cherry Creek at Franktown	A_2	10	16	10		75	150	1.3	2	0.02	-	0.16	0.18	0.03	0.06	-	-	-	-
Cherry Creek at mouth	B_2	20	25	8	4.6	650	4,750	3	61	0.6	2.7	2	4.5	2.5	5.8	800	6,000	1,000	22,000
Sand Creek at mouth	B_2	20	25	8.6	5.8	1,500	3,600	10	38	5	6	3	5.2	2.5	5	2,500	14,500	4,000	84,000
Clear Creek at Golden	B_1	10	13	7.3		275	500	2.5	5	0.23	-	0.4	-	0.2	-	400	600	200	400
Clear Creek at mouth	B_2	20	25	8.9	6.7	400	600	8	15	1.5	7.3	2	2.8	1.7	3.4	800	10,000	300	90,000
South Platte at Blakeland	B_1	15	18	7		250	-	5	-	0.01	-	0.03	-	0.05	-	15	40	32	40
South Platte at 38th Ave.	B_2	17	24	8.5		600	1,000	10	17	1.5	3.5	1.5	2.8	1	3.5	600	20,500	20,000	100,000
South Platte at Henderson	B_2	18	23	8.1	6.1	700	1,000	16	20	8	15	1.8	4	3	6.5	1,000	9,000	2,500	65,000

Table II-H. EXISTING WATER QUALITY (continued)
(1972)

Location	State assigned classification	Temperature, °C		Dissolved oxygen, mg/l		Total dissolved solids, mg/l		BOD, mg/l		Ammonia, mg/l		Nitrate, mg/l		Phosphate, mg/l		Fecal coliforms, MPN/100 ml		Fecal streptococci, MPN/100 ml	
		Avg	Peak	Avg	Min	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak
Summer/Fall																			
Bear Creek at Morrison	B_1	14	20	10.1		85	95	2.5	3	0.13	-	0.31	-	0.23	-	200	-	300	-
Bear Creek at mouth	B_2	21	28	8	5	250	3,600	2	41	0.15	1.8	1.0	4.3	0.3	1.7	300	18,000	700	140,000
Cherry Creek at Franktown	A_2	15	20	9.8		230	250	2.7	3	0.07	0.10	0.18	0.20	0.04	0.05	-	-	-	-
Cherry Creek at mouth	B_2	20	26	7.3	0.4	725	6,800	3	75	0.6	4.3	2.1	5.5	2.5	6.2	800	26,000	1,000	182,000
Sand Creek at mouth	B_2	20	26	8.2	6.2	1,200	3,300	6	35	3	6.5	3.5	4.5	3.5	8.5	2,500	12,500	4,000	56,000
Clear Creek at Golden	B_1	13	20	10		175	200	2	5	0.23	-	0.4	-	0.2	-	204	400	300	380
Clear Creek at mouth	B_2	22	28	8.2	6.2	400	600	8	13	1.2	2.5	2	2.3	1.4	1.5	800	10,000	300	90,000
South Platte at Blakeland	B_1	16	21	6.3		250	-	5	-	0.01	-	0.03	-	0.05	-	20	30	34	40
South Platte at 38th Ave.	B_2	20	26	8		650	4,600	10	16	1.8	3.6	1.8	4	1.5	4	600	16,000	20,000	130,000
South Platte at Henderson	B_2	20	27	7.6	5.4	700	2,000	10.2	16	7.5	12.5	2	3.5	4	6	1,000	10,000	2,500	75,000

two as streams progress through the urban area. With the exception of Sand Creek, levels for TDS are at or below limits recommended for specific water uses. The high TDS levels in Sand Creek are due in large measure to the nature of the creek bed, and the gravel mining which occurs on upstream portions of the stream.

Five day biochemical oxygen demand (BOD_5) levels generally are fairly constant throughout the year in the upstream portions of basin streams. The same is also true at the mouth of Cherry Creek. BOD_5 levels, where Bear and Clear Creeks enter the Platte and on the Platte below Littleton, decrease from winter highs to lowest levels in the spring instead of winter. These trends appear to indicate a greater influence from point sources during wintertime low natural stream flows. The highest BOD_5 levels in the South Platte occur at Henderson and the highest levels in tributaries occur at the mouths of Clear and Sand Creeks.

The downstream portions of Clear, Sand and Cherry Creeks, as well as the South Platte below Littleton, have ammonia (NH3) concentrations (in conjunction with pH and temperature) which are on the average at potentially toxic levels throughout the year. The highest levels, 10 milligrams per litre (mg/l), occur in the South Platte at Henderson during the winter. Highest ammonia levels generally occur in winter for the streams mentioned. Ammonia levels in the headwaters are at acceptable levels.

Nitrate levels throughout the South Platte basin are within recommended levels. However, these levels will maintain, and perhaps speedup present eutrophication. Table II-H shows that the highest levels occur in Sand Creek, Cherry Creek and Clear Creek where these creeks flow into the South Platte. These levels vary between 2.0 to 3.5 mg/l, which are significantly below the recommended limit of 10 mg/l for nitrate. However, recommended levels for total nitrogen are exceeded in the South Platte at Henderson, and nitrate levels in the South Platte are suspected of causing problems for the City of Thornton water supply.

Levels of phosphate, a pollution indicator, exceed recommended levels throughout the basin during the year except for wintertime levels in Cherry Creek above Cherry Creek Reservoir and the South Platte above Littleton which is at the limit. Phosphate levels increase downstream from upstream. The upper portion of Cherry Creek, above the reservoir, is the onlv headwater showing a variation in levels through a year. Bear Creek at the mouth had constant levels of phosphate, however, a seasonal trend is very pronounced for the remainder of the tributaries where they flow into the South Platte as well as for the South Platte itself. This trend begins with high levels during the winter, with generally lower levels throughout the remainder of the year until fall, when levels begin to climb to winter highs. Phosphate levels are highest in the South Platte at Henderson where levels of 5.0 mg/l occur. The next highest levels occur in Cherry Creek at the mouth, 2.5 to 4.0 mg/l, Sand Creek at the mouth, 2.5 to 3 mg/l, and Clear Creek at the mouth, 1.4 to 3 mg/l.

Fecal coliform recommended limits are met year round only in the South Platte above Littleton. They are equalled during summer, fall and winter in the headwaters of Bear and Clear Creeks, but are exceeded during spring. No data exists for Cherry Creek above Cherry Creek Reservoir, but a similar trend is expected. The higher levels in downstream portions of the basin are essentially constant throughout the year. The highest levels in the basin are found in Sand Creek at the mouth with 2,500 MPN/100 ml.*

Recommended limits for fecal streptococci, 20 MPN/100 ml, are exceeded throughout the South Platte basin throughout the year. The lowest levels, 32 to 40 MPN/100 ml, are found in the South Platte above Littleton. Fecal streptococci levels are essentially constant throughout the year except at the mouth of Cherry Creek where winter levels are substantially above levels for the remainder of the year. The highest levels in the South Platte basin occur in the South Platte at 38th Avenue in Denver, approximately one mile downstream of where Cherry Creek enters the South Platte. These levels are also found in Sand Creek at the mouth. Very high levels are also found in the South Platte at Henderson, 2,500 MPN/100 ml, and at the mouth of Cherry Creek, 1,000 to 1,800 MPN/100 ml.

The previous discussions were concerned with water quality during average conditions. Table II-H also indicates peak levels that occur during various seasons of the year. Data indicates that these peaks occur during runoff events, such as snowmelt and/or rain in the region. A review of Table II-H indicates that peak levels during runoff events at times exceed recommended levels which are in some measure met during average conditions for total dissolved solids (TDS), ammonia (NH_3) and total nitrogen.

Temperature and dissolved oxygen levels by themselves are not generally a problem during runoff events, and peak levels of nitrate are still within limits. Minimum levels of dissolved oxygen, not associated with runoff events, do occasionally fall below recommended minimums, particularly in the Lower South Platte and at the mouths of tributary streams during summer months. Levels for phosphate, fecal coliform and fecal streptococci, pollution indicators, generally exceed recommended levels during average conditions. The levels of these pollutants in the headwaters indicate a background level most probably caused by non-point sources further upstream.

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*MPN/100 ml means Most Probable Number of organisms per 100 millilitres.

The remaining discussions will be limited to TDS, ammonia and total nitrogen. Levels of TDS exceed recommended levels during runoff events throughout the year at the mouth of Bear, Cherry and Sand Creeks, and in the South Platte below Littleton. Levels are exceeded at the mouth of Clear Creek during spring, summer and fall. Few general statements can be made about trends because such factors as localized rain storms may have distorted the information given in Table II-H. Two observations can be made however. The highest peak levels of TDS occured in Cherry Creek, and the reason for this is not known. This was true for every season of the year. Also, peak TDS levels are generally highest during the winter at the mouth of the tributaries, and downstream from Littleton in the South Platte. These winter peaks correspond to small peaks in flow which infer that the wintertime TDS peaks are associated with snowmelt runoff from streets treated with salts.

Virtually no data exists for ammonia peak levels at the headwaters of the tributaries or for the South Platte above Littleton. The data for the lower reaches indicates recommended levels are exceeded during runoff events. No strong seasonal trends are apparent. The highest peaks in ammonia concentrations occurred in the South Platte at Henderson with concentrations of 12.5 to 15 mg/l.

Data on peak levels of total nitrogen are not available for the headwaters of the South Platte or its tributaries in the Denver region. The data for lower reaches indicates excessive levels during runoff events year around in Sand Creek and in the South Platte at Henderson, and in Clear Creek during winter and spring. No strong seasonal trends are apparent. The highest peaks occurred in the South Platte at Henderson with concentrations of 16 to 19 mg/l.

Big Dry, Coal and Boulder Creek Basins -- There are no significant existing data for these basins available for assessment of seasonal variations in water quality, nor are there sizeable amounts of data for assessment of non-point or point source water quality.

Water quality for Boulder Creek at its mouth (confluence with St. Vrain Creek) indicated an arithmetic mean of samples taken from 7 to 12 September 1971 for BOD_5 of 2.8 mg/l, total dissolved solids of 955 mg/l, fecal coliform of 1,080 MPN/100 ml and fecal streptococcus of 14,500 MPN/100 ml. It has also been noted that, below the Boulder/White Rocks treatment plant, chlorine and ammonia residuals preclude the migration farther upstream of sensitive fish species; fecal coliform and fecal streptococcus counts increase from upstream levels; and dissolved oxygen falls to a range of 6 to 8 mg/l from upstream levels of 9 to 12 mg/l. The headwaters of Boulder Creek were noted to have high levels of dissolved oxygen, and temperatures from November through March of 5°C. It has also been noted that phosphate levels are apparently higher than suggested levels for stream aesthetics (0.06 mg/l).

Coal Creek, in the upper portion of its basin, has temperatures and dissolved oxygen levels sufficient to support a put-and-take trout fishery. The lower portion's water quality was degraded in 1972 because of discharges from the Erie, Lafayette and Louisville municipal treatment plants and the former extraction of coals, and shows levels of fecal coliform and fecal streptococcus greater than 200 MPN/100 ml.

Water quality in the upper portion of Big Dry Creek Basin was unaffected in 1972 by point sources of pollution and has been suitable for use as a put-and-take cold-water fishery. It appears that levels of phosphate and total nitrogen are lower than suggested levels for these pollution indicators for stream aesthetics. In the lower portion, water quality is impacted by low releases from Standley Reservoir and point source inflows from the Westminster and Broomfield municipal wastewater treatment plants. Coliform levels periodically exceed suggested levels for urban irrigation and secondary-contact recreation.

Sources of Water Quality Problems --

This discussing will address the causes of water quality problems identified in the two previous sections of this report. It is based upon material previously referenced and consists of data generated during DRCOG's Clean Water Program water quality modeling and planning activities. Table II-I presents a summary of pollutant amounts in each basin under the headings of point sources and non-point sources. The following discussions are organized by basin as appropriate.

General -- The two indicators of pathogenic organisms, fecal coliforms and streptococci, are a consistent problem throughout the South Platte basin. Table II-I clearly shows that the overwhelming majority of these organisms come from non-point sources. Point sources of fecal coliforms constitute less than one percent of the total number, and point sources of fecal streptococci constitute less than one-tenth of one percent.

The levels of nitrate (NO_3) are not known to cause water quality problems, but it is suspected that they are contributing to a nitrite (NO_2) problem in the City of Thornton's water supply which is drawn from wells in the alluvial aquifers along the South Platte. The highest levels, 1.5 to 2.0 mg/l, are found in the South Platte below 38th Avenue. These levels are significantly below the recommended

Table II-I. COMPARISON OF ESTIMATED POINT AND NONPOINT SOURCE LOADING IN THE SOUTH PLATTE AND MAJOR TRIBUTARIES

(pounds per day)

Basin	BOD_5		TDS		NH_3		PO_4		Fecal coliform[c]		Fecal streptococci[c]	
	NPS[a]	PS[b]	NPS[a]	PS[b]	NPS[a]	PS[b]	NPS[a]	PS[b]	NPS[a]	PS[b]	NPS[a]	PS[b]
Bear Creek	908	18	77,300	410	80	9	70	5	1,441,000	37,850	9,553,000	7,600
Cherry Creek	2,500	65	207,200	5,770	180	27	180	97	3,975,000	50,720	27,757,000	6,400
Sand Creek	5,500	108	445,000	9,700	450	108	400	86	8,851,000	36,600	55,814,000	7,200
Clear Creek	4,120	4,800	349,000	68,300	340	770	300	1,080	6,049,000	72,000	39,693,000	17,000
South Platte												
South Metro	2,600	4,900	220,400	78,600	200	1,810	190	860	3,934,000	83,300	21,760,000	26,500
Middle	8,500	485	712,400	10,600	670	240	630	130	11,741,000	15,100	77,346,000	3,800
Lower	4,200	36,000	321,000	667,600	320	18,100	310	7,300	7,673,000	22,800	48,057,000	3,800
Totals	28,328	46,411	2,332,300	840,980	2,240	21,054	2,080	9,558	43,664,000	318,370	279,980,000	72,300

Note:
a. Nonpoint source loading are 1970 levels as given in Reference 215.
b. Point source loadings are estimated from yearly average effluent flows and quality for major municipal treatment plants as input to the Hydrocomp Model for 1972.
c. Values are in units of 10^6 per day.
d. Effluent levels estimated for Morrison sewage treatment plant.

level of 10.0 mg/l. Also, nitrates plus ammonia levels at Henderson exceed total nitrogen recommended levels of 10.0 mg/l in winter by 1.8 mg/l.

Bear Creek Basin -- Aside from occasional high temperatures in the headwaters and the aforementioned fecal coliform and streptococci problems, Bear Creek has levels of phosphates higher than recommended for current goals for beneficial use. Table II-I data indicates that less than seven percent of this potential pollutant comes from point sources. The pollution problems that do exist on Bear Creek are caused by non-point sources. The data cited for this discussion do not include the effects of construction of Bear Creek Lake Dam near Morrison, which probably is increasing suspended solids, TDS, and stream bed sediment loads.

Cherry Creek Basin -- The water quality problems in this basin, other than fecal coliform and fecal streptococci, occur below Cherry Creek Reservoir and are associated with high year round phosphate and ammonia levels, and high peak levels of TDS during runoff events. The Glendale treatment plant on Cherry Creek contributes significantly to the base flow of Cherry Creek, which is in turn lowest during winter. Most of the point source loads for ammonia and phosphate in Cherry Creek come from the Glendale treatment plant. Point-source loads account for 13 percent of total ammonia loads and 35 percent of total phosphate loads in the Cherry Creek Basin. Removal of phosphate from the Glendale treatment plant effluent would improve water quality, but instream phosphate levels would still be high, and potential water quality problems may occur. Removal of ammonia from the plant effluent to below current small levels may be of limited value without non-point source reductions. The high levels of TDS during runoff events reinforces the conclusion that this is essentially a non-point source problem. There is no current explanation as to why peak TDS levels are highest on Cherry Creek. It is suspected that the major source of TDS is Speer Boulevard, which parallels Cherry Creek on both banks for over three miles downstream from Glendale. Discharges of roadway runoff, carrying traffic generated pollutants and deicing chemicals into Cherry Creek, may constitute a major non-point source.

Sand Creek Basin -- The water quality problems associated with TDS, fecal coliform and fecal streptococci have been previously discussed and are principally a non-point source problem. The remaining major and potential problems on Sand Creek involved ammonia, phosphate and to a lesser extent BOD_5. Table II-I shows that the point source contributions are 20 percent, 18 percent and 2 percent, respectively, of total basin loads on an average basis. However, during periods of low or intermittent flow, point sources strongly determine water quality in Sand Creek. The major point source on Sand Creek is the Aurora treatment plant and it contributes significantly to water quality problems during base flow conditions. Effluent levels in 1972 for ammonia and phosphate were 10 mg/l and 8 mg/l, respectively. Reductions in these levels would benefit instream water quality, but recommended levels would still be exceeded.

Clear Creek Basin -- The major causes of water quality problems associated with BOD_5, ammonia, and phosphates are the point sources discharging to Clear Creek. Water quality in Clear Creek is determined by a complex interaction of seasonal flow variations, diversions, irrigation return flows and discharges from wastewater treatment plants. Determining the importance of any one of these influences in any detail is not possible with existing information. Water quality modeling information from DRCOG's Clean Water Program investigation is available only for the headwaters above Golden and at the mouth of Clear Creek.

There are five wastewater treatment plants discharging to Clear Creek. They are the Coors, Wheatridge, Clear Creek Valley, Arvada, and Crestview treatment plants. In 1972, the Coors plant effluent represented over 50 percent of total point sources loads for phosphates 12 percent for ammonia and 60 percent for BOD_5. 1976 effluent monitoring data indicates about the same percentages for phosphates and ammonia, but that the BOD_5 now represents about 40 percent of total average daily point source loads.

The major diversions of irrigation water, some of which becomes part of municipal water supplies, occur below the Coors plant. Further downstream some additional diversions occur, but effluent from the other four wastewater treatment plants and irrigation return flows also occur. As a consequence, the influence of the Coors effluent on downstream water quality is seasonal, and is essentially significant only during those periods of the year when irrigation water diversions are small or non-existent (generally November through March). The data in Table II-H illustrates this point. At the mouth of Clear Creek during the winter of 1972, the level of phosphates was 3.2 mg/l; ammonia, 4 mg/l; and BOD_5, 18 mg/l. During spring, summer and fall, these levels were 1.4 to 1.7 mg/l for phosphates, 1.2 to 1.5 mg/l for ammonia, and 8 mg/l for BOD_5. These decreases are due to increased flow in Clear Creek causing dilution, instream processes which are temperature sensitive and which reduce BOD_5 and ammonia, and the upstream diversion of most of the stream flow carrying Coor's discharged pollutants. Thus, the downstream discharges from the other four wastewater treatment plants are a major cause of poor quality in the lower half of Clear Creek during spring, summer and fall.

South Platte -- Point sources of BOD_5, ammonia, and phosphate clearly dominate over non-point sources in the South Metro portion of South Platte River (upstream from Bear Creek). These loads come from the Littleton and Englewood wastewater treatment plants. Although a new satellite plant to treat both Englewood and Littleton's wastewater is now operating, these point sources will continue to dominate water quality in this portion of the South Platte River.

In the South Platte. between Bear Creek and 38th Avenue (about one and one-half kilometres [one mile] downstream from Cherry Creek), non-point sources clearly dominate. The discharge from the South Lakewood wastewater treatment plant does contribute significant quantities of ammonia and phosphate, but the water quality is already degraded because of discharges from the Littleton and Englewood plants.

The impact of the discharge from the Metropolitan Denver Sewage Disposal District No. 1 (MDSDD #1) plant on water quality is overwhelming in the South Platte downstream from the Plant. This is not surprising considering the fact that about 40 percent of the total flow in the South Platte in 1972 was represented by the MDSDD #1 discharge. The percentage becomes 60 to 70 percent during winter low flow periods. As shown in Table II-I, pollutant loadings from the MDSDD #1 plant represents about 75 percent of the total point and non-point ammonia loadings in the entire Denver area. Comparable percentages for BOD_5 and phosphate are 45 percent and 60 percent, respectively. However, even if the MDSDD #1 plant discharged pure water, instream water quality would not be adequate for State designated uses of secondary-contact recreation and warm water fishery because of pollutant contributions from other point sources and non-point sources. The actual and potential pollutants of primary concern would be ammonia, phosphate, fecal coliforms and fecal streptococci.

Biology

Human settlement in the plains area has greatly changed the local ecology of the Denver area through alterations in land use and the introduction of non-native vegetation and animals. Urbanization to a great extent has removed many wildlife habitat areas from the region. Despite these changes, several areas still retain much of their original steppe community characteristics. Other areas, modified by human land use, have actually replaced some previously lost habitat and increased the diversity of the local environment. These are special habitat areas which are important to plant and wildlife ecology and do not tolerate great changes. A mapping of these sensitive areas is shown on Map F.

Within the Denver area, sensitive biological areas are generally associated with watercourses and bodies. While major river and stream systems provide valuable wildlife habitat, the area's poor water quality limits the populations and species diversity of the area's wildlife. Channelization of streambeds has greatly reduced this habitat along some stream sections. Gravel pit ponds, irrigation ponds, lakes and reservoirs provide important aquatic resting and feeding habitats for waterfowl and shore birds. The fringe areas of ponds and lakes, together with stream meanders, provide intermittant marsh habitat for wildlife as well. Several heron rookeries are located in protected areas. Cottonwood and willow groves create gallery forests along watercourses which provide important wildlife refuge areas and visual relief from the surrounding flat plains.

In the outlying areas, human activity is less intense and many areas still retain much of their natural condition. Selected prairie-grassland areas show examples of the native vegetation and habitat prior to conversion to agriculture. Numerous prairie dog towns are found in areas removed from human disturbance and invasion by domestic animals. The historic range of the black-footed ferret, which is protected by state and federal regulations, coincides closely with its prey species, the prairie dog. The changing prairie habitat and prairie dog control programs have indirectly, but strongly affected the black-footed ferret by reducing its prey. Of the larger grazing animals, mule and white-tailed deer are somewhat tolerant to human presence and are often found in the lower foothills and grasslands area up to the periphery of developed areas. The formerly wide ranging pronghorn antelope are found in the upland grassland and prairie areas in the southern part of the study area. Elk and big-horn sheep are generally confined to the higher elevation forest and bushland areas, but do descend to critical wintering areas in the foothills during extreme winter weather conditions. Peregrine falcons, an endangered species, have been occasionally observed in the mountainous forest and brushland areas. The Denver plains area may have some value as a feeding range for the species. Within Colorado, the white pelican is considered endangered as a nesting summer resident. White pelicans may be found at several reservoirs along the South Platte River. River otters, which are on the state's endangered species list, are very rare in Colorado and intolerant of human presence. Scattered sightings in the past have been reported along the South Platte River drainage in Weld County, outside of the Denver area. It is unlikely that a breeding population is present today.

Endangered or threatened plant species, typified by those found at White Rocks near Boulder, include *Asplenium andrewseii* (a rare fern), forktip three awn (*Aristida basiramea* - a grass) and American potatoe bean (*Apios americana* - a legume).

Energy

In the Denver area nearly 75 percent of all petroleum products are consumed by the transportation sector, compared to 50 percent nationally. Petroleum products represent 42 percent of the total energy supply utilized in the area, which is comparable to the national percentage. The industrial, residential and commercial sectors of the economy have nearly 60 percent of their energy needs supplied by natural gas. Natural gas supplies 41 percent of the region's total energy demand, whereas natural gas supplies about 31 percent of national energy demand. Projected shortfalls in supplies of natural gas may pose a constraint on growth in the Denver region after 1980. In the long term, increased reliance on coal-based electrical generation will force increased competition for available supplies of water, especially Western Slope water, which are necessary for coal mining and processing and air pollution abatement.

Historical Features

After becoming a part of the United States in 1803, as a result of the Louisiana Purchase, the natural resources of the Denver region attracted fur traders, gold miners, ranchers and farmers. Following the discovery of lode deposits in the mountains during the mid and late 1800's, the region's population grew rapidly and the City of Denver became a cultural, political and financial center. The region's historical sites are concentrated and distributed in several areas reflecting the influences of major events, such as the gold rushes and statehood. Sites concentrated along the edge of the mountains served as sources of supply and recreation for the mining populations. The concentration of sites in the Denver downtown area developed as Denver became the major supply point for the gold fields and eventually the state capital. Out on the plains, sites are situated along the major cattle, stage coach and pony express trails, which served the region before the advent of the telegraph and the railroad. Individual sites, mostly farm and ranch houses, are scattered throughout the plains area. The major historical sites in the Denver region are mapped on Map G.

Outdoor Recreation Sites

Several types of recreation areas, such as the South Platte Greenway, a proposed trail system along major streams linked to the Greenway, and the Barr Lake and Barr Lake Duck Club, are located near various existing and proposed wastewater facility sites (see Map G). Some counties have acquired park and open space lands which are to be developed as populations grow over the next fifteen or more years. Numerous parks and open spaces are currently being planned or proposed by the cities of Littleton, Denver, Lakewood, Wheatridge, Arvada and Aurora. Major problems being experienced by the Denver area's park agencies are vandalism and misuse of park and open space areas. These problems may become more difficult to deal with in the future as service areas become larger and uses become more intense. The recreational potential of most streamside parks, hiking trails and bicycle paths is limited by current water quality problems.

Aesthetics

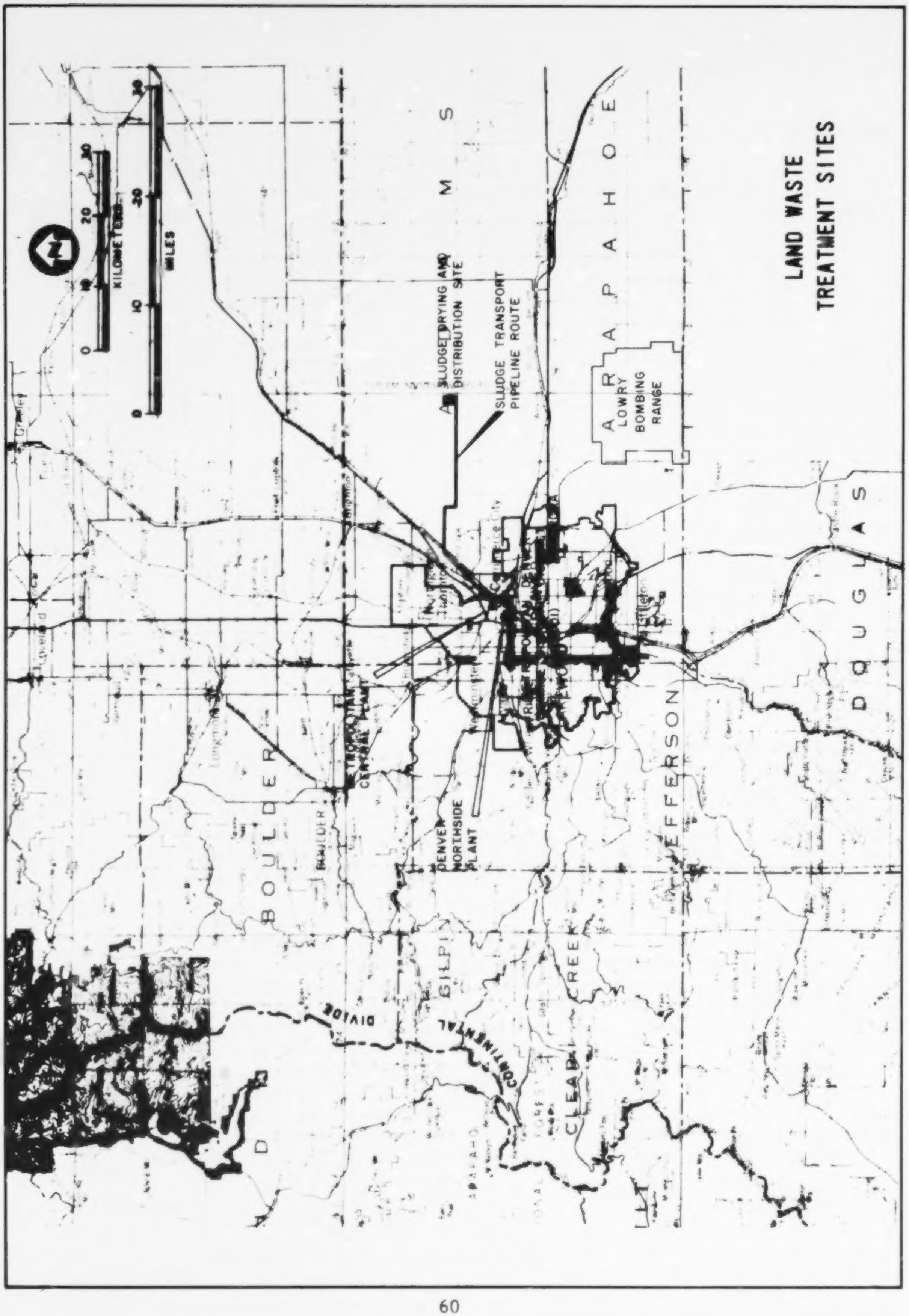
Amenities which make a strong contribution to the Denver region's quality of life include: the temperate arid climate; visual relief from the high plains topography by the abrupt face of the Front Range, recreational potential of the Rocky Mountains; landscaped and semi-natural areas within the urban area; open space areas surrounding the city; and social, cultural and economic institutions which strongly govern urban life styles. Of these, visual and open space amenities are the least well-defined and also the most susceptible to change. Visual perceptions range from panoramic background views, to areas of immediate perception, to distinct scenic or contrasting features. Further high-rise development in the central business district and commercial activity centers can significantly alter these perceptions. Examples of well-known scenic features within the Denver region are shown on Map G.

Land Waste Disposal and Reuse

In many areas, sludge, the treated solid component of sewage, is sold or applied to city-owned parks and other green areas as a soil conditioner, or disposed in landfills. The largest producer of sludge in the area, the Northside/MDSDD #1 wastewater treatment complex, dewaters undigested sludge to reduce its volume and trucks it to the Lowry Bombing Range where it is mixed with soil. Because of the high volume of sludge disposed at the range, this practice must be discontinued in the near future, and alternative plans are now being developed.

Improvements are under way and plans are being made to remedy the treatment complex's sludge disposal problems. Anaerobic digesters are being constructed at the MDSDD #1 plant that could eventually reduce the volume of sludge and make it more acceptable for land application. A long-range plan is being considered to transport sludge via pipeline to a drying distribution site in western Adams County (see Figure II-J) for drying and subsequent sale to farms in the area. EPA has issued a final EIS on this plan.

Direct and indirect reuse of treated wastewater for urban and agricultural irrigation already occurs in the Denver region. Direct reuse is the direct conveyance of treated wastewater from the treatment plant to point of use. Indirect reuse involves the discharge of treated wastewater to a stream which is subsequently diverted by downstream users. The waters of the South Platte are used many times by municipalities and agriculture before reaching the Nebraska Stateline, a situation not uncommon on most major rivers of the United States. About 25.7 million cubic metres (20,800 acre feet) of treated wastewater is currently directly reused. The vast majority, about 2.5 million cubic metres per year (19,900 acre feet), is used for


KILOMETERS
0
10
20
30
MILES
0
10
20
30
SLUDGE DRYING AND DISTRIBUTION SITE
SLUDGE TRANSPORT PIPELINE ROUTE
LOWRY BOMBING RANGE
DENVER NORTHSIDE PLANT
METROPOLITAN CENTRAL PLANT
A D A M S
A R A P A H O E
D O U G L A S
J E F F E R S O N
B O U L D E R
G I L P I N
C L E A R C R E E K
CONTINENTAL DIVIDE
Boulder
Longmont
Loveland
Greeley

LAND WASTE TREATMENT SITES

agricultural irrigation after diversion from the MDSDD #1 plant to the Burlington Ditch by the Denver Water Board. This diversion represents about 14 percent of the total yearly discharge of the plant. A portion of the effluent conveyed to Barr Lake contributes to the water quality problems of that recreational and wildlife area. The remaining 1.1 million cubic metres (900 acre feet) is used for urban irrigation of parks and golf courses. The cities of Northglenn and Westminster are currently completing arrangements for direct reuse of treated wastewater for agricultural irrigation in exchange for upstream diversions of water for municipal use. Also, Denver is planning to construct a 0.04 cubic metre per second (1.0 million gallons per day) pilot treatment plant for producing potable water from wastewater effluent. Ultimate plans are for a 4.4 cubic metre per second (100 million gallons per day) plant if safety considerations and public acceptance permit.

All reuse schemes are, in effect, a means of increasing water supply. They may also have the potential of improving stream water quality by diverting relatively polluted discharges from streams to some reuse, such as irrigation. Water quality "benefits" are sometimes difficult to define because a substantial portion of the flow in a particular stream, such as Cherry Creek, may depend on point source discharges. Benefits from improved quality in terms of pollutants may be offset by diminished flow. The communities in the Denver region are interested in reuse schemes because they stretch or augment existing water supplies. This interest will continue and intensify.

Traffic

In 1974, 97 percent of all intracity trips in the region were made by automobile. The existing highway system becomes overloaded at peak traffic times in several areas, and the situation is expected to worsen due to further population growth, and suburban development patterns and situations. The nature of these overloaded conditions is generally a reduction of traffic flow speeds by 16 to 48 kilometres per hour (10 to 30 miles per hour). The "linear parking lot" traffic jam situation is not as common in Denver as in cities such as New York and Los Angeles. Some of the major highways and arterials presently experiencing rush hour overload conditions include:

1. Broadway from the Central Business District (CBD) to Englewood.
2. I-25 (Valley Highway) from the Denver-Boulder Turnpike Interchange south past U.S. Highway 6.
3. The I-70/I-25 interchange, nicknamed the "mousetrap".

4. Federal Boulevard, Speer Boulevard, Alameda Avenue, and Santa Fe Drive as they approach the inner city.

5. Wadsworth Boulevard, Hampden Street, Sheridan Boulevard and Colorado Boulevard as they approach the major thoroughfares carrying traffic in and out of the CBD.

Present attempts to remedy traffic problems include further highway construction, such as that being planned in the southwest area of the region to relieve traffic congestion. Also, the Regional Transportation District (RTD), the Colorado Department of Highways (CDH) and DRCOG are in the process of developing a transportation system management plan that will make better use of the existing transportation system. Such things as ramp metering and preferential treatment of high occupancy vehicles are only two of many strategies being investigated to help conserve energy and improve air quality.

Plutonium Contamination and Radiation Hazards

The extent and significance of soil and airborne contamination caused by the plutonium processing plant at Rocky Flats is under intense investigation by state and federal agencies. Various agencies are concerned that plutonium contamination may have occurred as a consequence of the fire at the Rocky Flats Plant in 1969. The transport of plutonium contamination easterly from the plant is known to have occurred. Whether contamination levels are hazardous to human health has not been decisively determined. Investigations are now underway to determine the extent of contamination of the ground surface, Great Western Reservoir, Standley Lake, and whether wind pickup of surface contamination represents a hazard. Ultimately, certain land areas generally east of Rocky Flats may be banned from residential development.

The Colorado Health Department (CHD) is currently investigating the radioactive material content of wastewater treatment plant discharges and sludges. CHD is concerned that radioactive materials may be entering wastewater treatment systems from sources such as hospitals and universities, as well as some industries. CHD is also concerned about the possible contamination of water sources by runoff from uranium mining areas in the mountains.

SOCIO-ECONOMIC ENVIRONMENT

The term "socio-economic" embraces all of those conditions and activities that relate to man's habitation and use of his environment. Housing, employment, community services and facilities and the institutional structure, through which demands for these goods and services are communicated, all form a part of the socio-economic setting. This section presents first basic data on the regional economy, population and land use. Subsequent sections discuss community services and facilities, agricultural land use, and regional planning policies.

Regional Economy, Population and Land Use

The Economy --

The Denver region enjoyed significant economic expansion in the past three decades, and particularly in the 1960's. Employment in all major nonagricultural sectors of the region's economy grew at a faster rate than in the nation during the second half of the 1960's, and is expected to continue to surpass national growth through the 1970's (Reference 905). During the 1940-1970 period, employment in the five-county Denver region increased at an average rate of 3.7 percent per year, while state and national employment grew at rates of 3.0 percent and 1.7 percent, respectively (Reference 259). In 1970, about 60 percent of Colorado's employment was located in the five-county Denver region.

In 1975, nonagricultural employment in the Denver region numbered about 661,400. About 65 percent of these jobs were concentrated in three sectors; trade, services and government (including military). Denver's economic mix is more strongly concentrated in the service-producing sectors than in the goods-producing sectors. In the U.S. as a whole, 23.8 percent of nonagricultural employment is in manufacturing; in Denver, the comparable proportion is 14.3 percent (Reference 999 and 259). However, a few manufacturing activities are significant exceptions. Machinery, electrical products, luggage and rubber manufacturing are considered major contributors to the "exports" of the Denver region; that is, economic activities which result in the sales of products to markets outside the region. With these exceptions, however, most of Denver's export activity is in the service sectors: TCU (transportation, communications and utilities), trade, services and FIRE (finance, insurance and real estate). Employment concentration in these sectors reflects Denver's role as a regional finance and distribution center for the Mountain States.

Recent trends in employment suggest that strength in the service sectors is becoming more marked. While there has been significant growth in all economic sectors since the mid-1960's, growth in trade, FIRE and services has been much more rapid than in manufacturing, as Table II-J indicates. However, construction employment continues to grow quite rapidly - a tangible indicator of growth in all sectors.

Table II-J. RECENT TRENDS IN NONAGRICULTURAL EMPLOYMENT BY SECTOR IN THE FIVE-COUNTY DENVER REGION

Sector	Annual Growth Rates, % 1964-70	1970-75	Current Employment
Mining	2.8	5.7	7,800
Construction	3.6	5.6	42,500
Manufacturing	4.7	1.7	94,700
TCU (transportation, communications and utilities)	3.0	2.3	42,100
Trade	4.5	4.8	161,600
FIRE (finance, insurance, real estate)	4.1	6.9	44,900
Services	5.9	5.4	143,400
Government (including military)	4.4	3.9	124,400
Total Nonagricultrual Employment	not tabulated	4.2	661,400

Source: DRCOG. Figures for 1964-70 cited in Reference 304 and figures for 1970-75 cited in Reference 259.

A significant recent trend in employment growth is in the mining sector. This sector includes extraction of minerals occuring naturally (coal and ores, liquid petroleum and natural gas), quarrying, well operation-exploration and development, and related off-site employment. Much of the recent growth in the Denver region's downtown office employment is reportedly in the extractive industries, with a number of major firms using Denver as the base from which to supervise exploration and energy development activities in the Mountain States. This trend has been experiencing very low vacancy rates; downtown office construction is expected to continue to prosper, at least in the short run (Trenka, personal communication).

The distribution of employment among the counties of the region has been changing over time: as the four outer counties have urbanized, the City and County of Denver has represented a decreasing share of the region's employment. Figure II-K depicts shifts in county shares graphically.

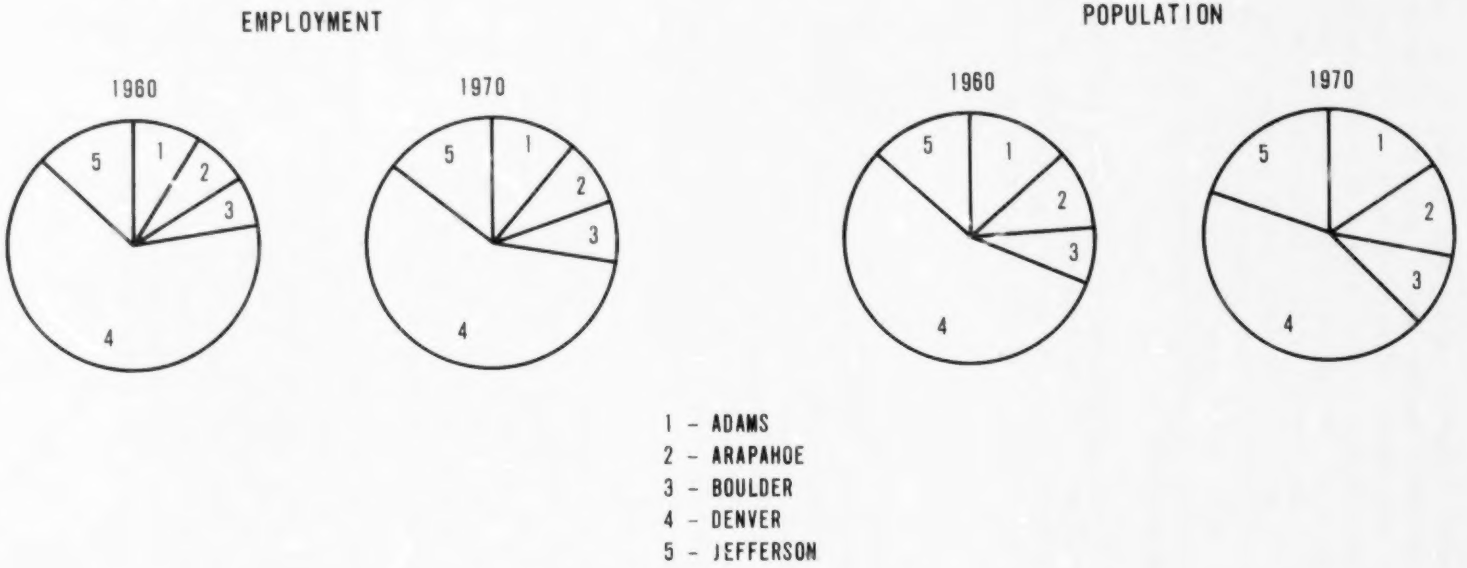
Population --

In recent years, Denver has been one of the nation's fastest growing metropolitan regions. During the 1960's, the Denver Metropolitan Area grew annually between 3 percent and 4.6 percent, considerably more rapidly than the state's 2.3 percent average annual growth. Over half of Colorado's population lives in the five-county region (Reference 304). Figure II-K presents a graphic depiction of distribution of the region's population by county in 1960 and 1970. Table II-K presents demographic characteristics of the Denver region's population in 1970.

Population growth is composed of two elements: the excess of births over deaths, (net natural increase) and the excess of in-migrants over out-migrants. While death rates remained fairly stable, birth rates have dropped over 40 percent since 1960. A majority (60 percent in 1975) of the total population increase in the Denver region is attributable to net in-migration. Table II-L presents county estimates of population change of both types in 1975.

In the period from 1940 to 1970, annual net in-migration to the region averaged 15,000 (Reference 401). Recent years have seen the suburban counties - particularly Jefferson - attracting the lion's share of net in-migrants, as Table II-M indicates. It should be kept in mind, however, that net migration figures do not reflect total movement. The City and County of Denver may be receiving a large absolute number of newcomers, but its loss of residents to the suburban counties may exceed the number of new residents it receives from outside the region, at which point its absolute population declines.

FIGURE II-K



REGIONAL EMPLOYMENT
AND
POPULATION BY COUNTY[a]

[a] EXCLUDES EASTERN ADAMS AND ARAPAHOE COUNTIES AND WESTERN BOULDER COUNTY. SOURCE: REF. 262.

Table II-K. DEMOGRAPHIC CHARACTERISTICS OF THE DENVER SMSA[a] POPULATION, 1970

Family Income			Age Distribution			Ethnic Distribution		
Income categories	Number of Families	Percent	Categories	Number of Persons	Percent	Ethnic Group	Number of Persons	Percent
Less than $3,743[b]	20,572	6.8	Less than 15	362,195	29.5	White	1,021,477	84.6
Less than $4,999	43,172	14.2	Less than 19	477,904	38.9	Spanish surname	138,928	11.3
From $5,000 to $14,999	185,713	61.0	From 20 to 54	564,078	46.0	Black	50,159	4.1
More than $15,000	75,580	25.0	Older than 55	185,547	15.1			
			Older than 65	95,046	7.7			
Median $10,777			Median 26.5					

a. The Denver Standard Metropolitan Statistical Area (SMSA) includes Adams, Arapahoe, Boulder and Jefferson Counties.

b. Poverty level.

Table II-L. COMPONENTS OF ESTIMATED RESIDENT POPULATION CHANGE, 175

County	Births	Deaths	Net Natural Increase	Net In-Migration	Total Increase
Adams	3,721	1,110	2,611	389	3,000
Arapahoe	2,880	1,060	1,820	5,280	7,100
Boulder	1,965	879	1,068	3,614	4,700
Denver	6,468	4,918	1,550	-4,950	-3,400
Jefferson	4,289	1,578	2,711	12,711	12,289
TOTAL	19,323	9,545	9,778	16,622	26,400

Source: Reference 208

Table II-M. DISTRIBUTION OF NET IN-MIGRANTS TO FIVE COUNTIES, 1970-1972

Year	Adams County	Arapahoe County	Boulder County	Denver County	Jefferson County
1970	20.0%	18.2%	13.8%	2.3%	45.7%
1971	19.5	24.1	16.4	2.7	37.3
1972	13.3	25.9	16.5	1.5	42.8

Source: Reference 128

The general pattern of population change in the region has been that of a central city (Denver) representing a declining proportion of the region's population. Since 1960, the population of the City and County of Denver has grown more slowly than at any other time in the twentieth century. One study points to the increasing resemblance between Denver's patterns of population change and those of older urban core cities, especially in the East and Midwest.

> The overall picture presented is one of Denver as an aging urban core city increasingly populated by the poor; less educated; the minorities; the less easily employed; the elderly; and the working young adult households. It is also one of Denver surrounded by a solid suburban ring populated by the white majority; the affluent;

> the better educated; the family households with children and with adults in their most productive years; and the higher skilled and more easily employable. (Reference 905)

In-migrants to Denver tend to be the elderly, minorities, and young adults; this pattern may be accompanied by higher unemployment, lower levels of educational attainment and lower household incomes. The pattern will cause the existing social dochotomy between core city and suburb to become more pronounced over time. However, there are some indicators that the "white flight" to suburbia is slowing with more affluent families moving back to the city center.

Land Use --

The most striking characteristic of regional land use is its dispersed pattern and low density. In the City and County of Denver, population density was about 3,370 persons per square kilometre (5,418 persons per square mile) in 1970, with about 125 persons per square kilometre (200 persons per square mile) in the four suburban counties for an SMSA average of 210 persons per square kilometre (335 persons per square mile). Of the 34 metropolitan regions having populations exceeding 500,000 in 1970, only five (Dallas-Fort Worth, Houston, San Diego, Riverside-San Bernadino, and Portland) had lower densities. In fact, population density in the Denver region was less than that in many suburban counties of other regions. Isolation from other urban areas, preference for open space and the high mobility made possible by the extensive highway network are reasons given for the overall suburban density of this urban region (Reference 304).

Growth in recent years has shifted the distribution of many land use categories from the City and County of Denver to the outlying counties. In the case of single-family residential, the regional concentration of this development shifted to Jefferson between 1960 and 1970. Multi family housing, too, has increasingly been a suburban phenomenon, and retail/service commercial activity has followed the shift in population. Suburbanization of major industry has begun recently and is expected to continue (Reference 905). Agricultural land use declined by about 9 percent; this decline is discussed in Section IV. Table II-N presents a land use tabulation by county for 1960 and 1970.

Many local officials have observed that land use patterns in the region have thus far developed more in response to economic pressures than as the result of conscious planning. This has occurred in part because existing zoning is in conflict with the regional plan: while a regional population forecast of 2.35 million has been adopted DRCOG found in 1972 that the population holding capacity of zoned land exceeded six million. The study of existing zoning concluded that the region was greatly overzoned: "at present, every city and

Table II-N. COUNTY LAND USE SUMMARY, 1960 AND 1970
(1000 acres)

County[a] & Year	Single-family	Multi-family	Commer-cial	Ser-vices	Industrial, Transporta-tion & Com-munications	Parks & Recrea-tion	& Semi-public	Agricul-tural	Vacant	Total
Adams										
1960	6,266	265	482	54	10,813	320	18,676	189,542	16,590	
1970	9,947	928	994	177	14,155	1,173	18,642	177,241	19,751	243,008
Change	+ 59%	+250%	+106%	+228%	+ 31%	+267%	0%	-6%	+19%	
Arapahoe										
1960	6,688	343	360	120	7,990	4,642	13,077	80,161	13,428	
1970	11,797	653	760	310	10,190	5,187	7,760	74,923	15,229	126,809
Change	+76%	+90%	+111%	+158%	+27%	+12%	-41%	-6%	+13%	
Boulder										
1960	5,935	382	564	72	7,510	46,897	3,128	138,958	79,474	
1970	9,775	951	910	153	9,236	47,781	3,781	133,867	76,466	282,920
Change	+65%	+149%	+61%	+112%	+23%	+2%	+21%	-4%	-4%	
Denver										
1960	15,146	2,306	1,253	539	19,781	3,079	4,802	7,403	9,122	
1970	16,918	2,998	1,672	613	23,000	3,559	3,813	1,985	8,873	63,431
Change	+12%	+30%	+33%	+14%	+16%	+16%	-21%	-73%	-3%	
Jefferson										
1960	11,325	411	638	951	13,738	125,497	6,059	76,867	262,680	
1970	18,148	892	1,338	966	17,834	128,127	6,648	71,335	252,878	498,166
Change	+60%	+117%	+110%	+2%	+30%	+2%	+10%	-7%	-4%	
Total[a]										
1960	43,360	3,707	3,297	1,736	59,832	180,435	45,742	492,931	381,294	
1970	66,585	6,422	5,674	2,219	74,415	185,827	40,644	459,351	373,197	1,214,334
Change	+47%	+73%	+72%	+28%	+24%	+3%	-11%	-7%	-2%	

[a] Excludes western Boulder and eastern Adams and Arapahoe Counties.

Source: Reference 205

county has zoning far in excess of that needed to accommodate its present population" (Reference 258). See Map H.

Under these circumstances, zoning has not been an effective tool in implementing land use planning. Much of this overzoning is reported by local jurisdictions to have been the result of pre-zoning when annexations took place. As a practical matter, rezoning cannot easily be accomplished until the land is proposed for development, and even the rezoning may not be possible. Many local public officials interviewed in the course of this study expressed the view that a state law requiring zoning to be consistent with comprehensive planning would help to solve this problem; however, some also pointed to the common acceptance of the zoning map as the community comprehensive plan. No ready solution to the over-zoning problem was identified.

Community Services and Facilities

A wide variety of government services are provided by local jurisdictions in the Denver region. These jurisdictions include 25 municipalities and 201 special service districts within a four-county area of the region (Adams, Arapahoe, Denver and Jefferson Counties). A recent study of taxation and finance in the region (from which the data in this section are taken) found that these jurisdictions spent approximately $920 million in 1974 ($747 per capita) as compared with total revenues to the State of Colorado of $958 million in fiscal year 1974-1975 (Reference 987).

The major local cost is for public education, which ranges from $232 (Denver) to $320 (Arapahoe) per capita; total county per capita expenditures (that is, total expenditures of all local service agencies and municipalities within county boundaries) ranged from $571 (Jefferson) to $835 (Denver) per capita. The service ranking second in per capita cost is water and sewerage. For a number of reasons, including the fact that costs paid to private water and sewerage agencies are not included in the estimates of public costs, average water/sewerage costs were found to vary widely throughout the Denver region. Compared to a regional average of $70 per capita, the county averages (1974) are $92 (Adams), $75 (Arapahoe), $60 (Denver), and $48 (Jefferson). Among municipalities, even greater variability was observed: Commerce City has per capita water/sewerage costs of $142; Englewood, $93; Golden, $66; Arvada, $46; and Wheatridge, $28.

The Denver Metropolitan Study report on finance and taxation (Reference 1005) considers several issues related to revenue, expenditure and service delivery organizations. On the question of distributional equity (taxation burden relative to ability to pay) the study found that the City and County of Denver, with 43 percent of the population in the four-county area of the region, accounts for 42 percent of the gross personal income. "This suggests that on the aggregate, the City/County is not seriously disadvantaged in terms of ability to pay as measured by gross personal income". The study did point to a disparity among counties in terms of personal income per capital; Arapahoe, $4,994; Jefferson, $4,718; Denver, $4,260, Adams, $3,516. "The real disparity within the region is between Adams County and the other three counties".

A second important issue is that of the organization of service delivery. The 201 special districts in the four counties account for 10 percent of all local revenues. Because these districts cut across municipal, county and other special service district boundaries, they make efficient planning and administration of services extremely difficult. Even obtaining information from such districts (one-third have no paid staff) proved very difficult to the Metropolitan Study research team. The study concluded that fractionated districts (1) make accountability uncertain; (2) result in higher costs; and (3) involve double taxation. It is the special district system which is responsible for the wide variation in municipal property taxes, with the resulting unevenness in the cost of public services to individual taxpayers.

Table II-O presents a summary of user and service charges imposed by the local agencies proposing new wastewater facilities.

Agricultural Land Use

There are three terms frequently used in analyzing the effects of urbanization on agriculture. They are "agricultural land", "prime agricultural soils" and "prime farmland". Agricultural land is a term most frequently used by land use planners and generally refers to any land being used for agricultural purposes. This could be anything from hilly range land to irrigated truck farms. Prime agricultural soils are land areas which have all the necessary physical, chemical and topographic characteristics, except sufficient moisture, to support high-quality agricultural production. Within the context of the arid Denver region, prime farmlands are areas of prime agricultural soils under irrigation. The distinction between prime agricultural soils and prime farmland is made in this EIS because of the need to identify potential as well as existing highly productive agricultural resources. Land is an in-place resource whereas the water required to fully use the land resource is relatively transportable.

Table II-O. SUMMARY OF AVAILABLE INFORMATION ON USER CHARGES

Agency	Facility Plan service area/project	User charge rate structure						Remarks
		Service charge			Tap fee			
		Residential	Commercial	Industrial	Residential	Commercial	Industrial	
South Adams County Water and Sanitation District	South Adams	$2.80/mo[a]	$2.80/mo[a] + 25% of water charges above 53,000 gal.	percent of metered water consumption[b]	$235/unit[a]	per unit[b]	per unit[b] (negotiable)	received ~ 47.0% of revenue from mill levy in 1972[b]
City of Littleton	Littleton/Englewood	$2.75/mo[a] % of water bill[b]	$2.75/mo[a] per equivalent dwelling unit	meter size[b]	$300/unit[a]	per sq ft[b] or negotiated	negotiated	
City of Englewood		$1.25/mo[a] within city $1.75/mo[b] outside city	$1.25/mo[a]	% of water bill[b]	$300/unit[a]	per sq ft[b] or acreage	per sq ft[b] or acreage	
City and County of Denver, Wastewater Division	Cherry Creek/ Goldsmith Gulch Northside Plant	101% of water rate[e] water rate = $.49/1,000 gal.[a]	95% of water bill[a]	150% of water rate plus surcharge	$300/unit[a]	f.	f.	
Metropolitan Denver Sanitary Disposal District #1	Lower South Platte Clear Creek Sand Creek main plant expansion	-	-	-	-	-	-	MDSDD#1 charges user on following basis[c]: flow @ 45.51% BOD @ 30.88% SS @ 23.61%
City of Broomfield	Big Dry Creek	$3.50/mo[b]	per unit[b] + % of water bill	per unit[b] + % of water bill	$580/unit[a]	per unit[b]	per unit[b]	
City of Westminster		$.65/1000 gal./mo.	negotiable contract	negotiable contract[b]	$720/unit[a]	per pipe size	per pipe size	
South Lakewood Sanitation District		none	none	none	$401/unit[d]	-	-	4.16-mill levy for general revenue

[a] Reference 976 and GCDPW. [b] Reference 120, 1972; [c] Reference 313, 1976; [d] personal communication, John Erus, 8 February 1977. [e] In effect as of 31 Dec.73

[f] Tap fees are set per rate schedule as developed by the Manager of Public Works.

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Land in Agricultural Use --

The fringes of the Denver Metropolitan Area contain a great proportion of highly productive farmland. Soils are generally deep, friable, well-drained, flat and fertile. Table II-P shows a total of 122,130 hectares (301,790 acres, 1973) of land in the agricultural areas likely to experience growth pressures before the year 2000. The figures shown are for DRCOG's "empiric counties", i.e. those urban and urbanizing portions of the political counties in the region which provide the areal basis for population projections. Of the 122,130 hectares (301,790) total shown in Table II-P, 35,600 hectares (88,000 acres) have been identified as prime farmland (Reference 265).

Table II-P. 1973 ESTIMATES OF AGRICULTURAL ACREAGE BY EMPIRIC COUNTY IN THE DENVER REGION

County	Rangeland	Non-Irrigated Cropland	Irrigated Cropland	Total Agricl. Lands[b]
Adams	10,750	16,070	32,790	59,610
Arapahoe	38,940	20,550	830	60,320
Boulder	30,000	10,950	74,120	115,070
Denver	3,470	1,100	2,510	7,080
Douglas		No Available Data		
Jefferson	41,540	10,750	7,420	59,710
Weld		No Available Data		
TOTAL	124,700	59,420	117,670	301,790

[a] Empiric County boundaries designated by DRCOG, 1973.

[b] Total agricultural lands within Empiric Counties (Reference 257).

Table II-Q shows a total of 158,650 hectares (392,040 acres) of existing agricultural lands in the region beyond the boundaries of the empiric counties. More simply stated, Table II-Q is an estimate of agricultural lands in the region which are generally, but not exclusively, beyond the leading edge of the urbanizing fringe.

Table II-Q. 1973 ESTIMATES BY POLITICAL COUNTY OF EXISTING AGRICULTURAL LAND WITHIN THE REGION'S MAJOR DRAINAGE BASINS, [a]BUT OUTSIDE THE EMPIRIC COUNTY BOUNDARIES

County	Rangeland	Non-Irrigated Cropland	Irrigated Cropland	Total Agricl. Lands
Adams	0	2,790	41,470	45,260
Arapahoe	0	24,130	11,410	35,540
Boulder	51,300	8,230	4,120	63,650
Denver	0	0	0	0
Douglas	137,560	34,960	7,700	180,220
Jefferson	41,140	10,300	1,720	53,160
Weld	1,430	3,540	9,240	14,210
TOTAL	231,430	84,050	75,660	392,040

[a] Major drainage basin boundaries designated by DRCOG, 1973

[b] Total agricultural lands outside of empiric counties, but within the region's major drainage basins (Reference 257).

Using published and other available soils information, the lands with prime agricultural soils, i.e. those lands having the fewest limitations for various agricultural uses, were mapped as shown on Map D. This map was prepared principally for regional impact assessment. Criteria used to determine prime soils included the U.S. Soil Conservation Service soil capability rating and predicted crop yields. They did not include such site-specific variables as economic feasibility and value, land ownership, availability of irrigation water, and energy requirements for crop production. These criteria for both irrigated and dryland operations were mapped as accurately as the available soil maps permitted. Areas currently in urban development were excluded from consideration. However, current zoning and political boundaries did not influence the mapping.

The Economic Value of Agricultural Activity --

Denver is a major agricultural and livestock trading center. Beef cattle dominate the livestock market, while major crops include alfalfa, small grains, corn and sugar beets (Reference 104). Agriculture accounts for 6 percent of the region's employment (as compared with 3.5 percent of the nation's employment) (Reference 994 and 995). In terms of crop values, the most important single crop is winter wheat, which in 1974 accounted for almost 43 percent of the value of regional crops as indicated in Table II-R.

Table II-R. VALUE OF CROP POPULATION BY COUNTY, 1974
(in 000's of Dollars)

County	Winter Wheat	Corn (Grain & Silage)	Hay	Sugar Beets	All Other Crops	Total
Adams	13,329.0	3,458.0	2,359.5	1,333.0	3,866.2	24,345.7
Arapahoe	4,070.0	394.3	718.1	---	601.5	5,783.9
Boulder	706.6	3,357.0	2,219.0	2,390.0	2,694.2	11,366.8
Jefferson	293.4	136.0	829.5	---	369.0	1,627.9
TOTAL	18,399.0	7,345.3	6,126.1	3,723.0	7,530.9	43,124.3

Source: Reference 984

Agricultural activity in the region creates jobs in other sectors of the economy, as Denver region firms in such sectors as manufacturing, finance and trade provide goods and services to agriculture. One study traced the economic effects of agricultural activity on irrigated lands in Adams County and found that 100 agricultural jobs create the demand for 82 nonagricultural jobs, with the majority of these in the manufacturing and service sectors (Reference 986). This estimate includes only the direct economic effects of agriculture; it excludes jobs generated within each nonagricultural sector due to demand by other nonagricultural sectors for goods and services needed to meet requirements of agriculturalists. If all these inter- and intra-sectoral economic linkages were quantified, the result would be an estimate of an agricultural "multiplier" for the Denver region: a measure of the total economic impact of regional agriculture on the regional economy. No research on this subject was found; however, for the State of California, an agricultural multiplier has been estimated as between 3 and 4, meaning that for each $1 of agricultural production, the state enjoys $2 to $3 of additional economic product related indirectly to agriculture (Reference 991).

Future Prospects for Regional Agriculture --

Denver's role as a regional center of finance and trade will permit it to continue to capture agriculture-related jobs in nonagricultural sectors, even as agriculture activity becomes increasingly distant from Denver due to urbanization and other factors. Loss of agricultural employment in the five-county regions is a reasonable expectation. DRCOG forecasts that this decline will be the order of about 12 percent between 1975 and 2000 (Reference 259). This need not necessarily mean loss of production, as historically productivity increases have more than made up for reductions in farm labor. However, loss of agricultural land or water supply to urban uses may result in a decline in agricultural output.

Much of the Denver region's growth since 1950 has taken place on land formerly in agricultural production. In Adams and Arapahoe Counties in the 1960's, about 56 percent of the gross addition to urban land came out of the cropland category (Reference 719). Not withstanding the conversion of agricultural land to urban uses, the total area in cropland did not decline, because land and other open land categories (primarily pasture and range land and open idle land) was converted to cropland. However, total land in the agricultural category did decline 13,510 hectares (33,580 acres) or 7 percent. Similar patterns have been noted in other regions (Reference 719 and 127).

Indirect effects of growth are causing further pressures. These indirect pressures are manifested principally through increases in the cost of water and the increased demand for water by municipalities. This latter point is illustrated by the current condemnation proceedings initiated by the cities of Thornton and Westminster to affect conversion of agricultural irrigation water rights to municipal use. Loss of water would probably result in the conversion of irrigated cropland back to dry land farming and grazing, increased land speculation, and an overall decrease in productivity and amount of land in agricultural production. Coupled with these pressures, the current drought, and the unsatisfactory returns on cultivated land farmers have experienced in the last few years are causing serious difficulties for the agricultural sector of the region's economy. The prognosis is not favorable.

Regional Planning Policies

Regional planning for the Denver Metropolitan Area has had an interesting and sometimes even turbulent history. Until recently, land use and transportation planning were done jointly by an organization known as the Joint Regional Planning Program or JRPP. The three participants in this program were the State Division of Highways (CDH), the Regional Transportation District (RTD), and the Denver Regional Council of Governments (DRCOG). Early in 1977, the DRCOG was designated as the Metropolitan Planning Organization by the Governor and, as such, is now responsible for transportation planning. Additionally, DRCOG has had a history of being the regional land use planning and population forecasting body, and also provides many other regional planning functions. The Denver Regional Council of Governments represents 37 local governments throughout the metropolitan area. In 1973, DRCOG adopted a year 2000 regional land use plan (see Map I) along with a set of policies which outline the population and land use guidelines for growth in the region. One of the most significant of these policies is the statement that:

> "A population level below 2,350,000 should be encouraged for the Denver Metropolitan Statistical Area by by year 2000".

The DRCOG issued in July 1977 for public discussion, a Draft Regional Growth and Development Plan which is intended as a refinement and restatement of the current Regional Land Use Plan. Action on the draft plan is not expected until March or April 1978. The draft policies from the draft plan are included as an appendix to Volume 1 of this EIS. Various approaches to implementing the Draft Plan were analyzed in a separate Implementation Prospectus issued in September 1977. The most feasible appeared to be the creation of a metropolitan/policy making organization which would supercede DRCOG, but be governed by a body of directly elected and appointed locally elected public officials.

The Council of Governments is also the designated agency responsible for water quality management planning in Denver under Section 208 of the Federal Water Pollution Control Act of 1972. In developing the Clean Water Plan, the DRCOG adopted an allocation by municipality of the year 2000, 2.35 million population forecast.

Another agency responsible for regional water planning in the metropolitan area is the Urban Drainage and Flood Control District. The Flood Control District is responsible for comprehensive and project planning for urban flood and runoff control to safeguard the public and property. The District was formed by the state legislature in 1969. Although responsible for flood control for urban runoff events, the District has been reluctant to assume responsibility for urban runoff water quality.

Presently, no single agency is responsible for regional planning of water supplies for Denver. However, the Denver Water Board presently supplies nearly two-thirds of the municipal raw water used in the region.

The Regional Transportation District (RTD), which was formed by the state legislature, has the responsibility for improving bus service within the region and for developing a new fixed-line transit system for metropolitan Denver.

The Colorado State Government also has an important role in planning and policy-making which directly effects the Denver region. The State Division of Highways is responsible for many areas relating to transportation planning in Colorado and Denver, including road improvements and construction.

The Colorado Division of Planning serves as an advisory and coordinating agency. It was created within the Department of Local Affairs, to, among other things, prepare planning:

> "For meeting problems in areas of highways, air and water pollution, water supplies, sewage disposal, recreation, urban and non-urban growth, transportation, education, industrial and commercial development and related matters".

In addition, the Colorado Land Use Act established within the Office of the Governor, the Colorado Land Use Commission in order to provide the leadership to encourage planned and orderly land use development. In a related matter, Governor Lamm issued a policy statement on growth in Colorado in 1976. Probably the most significant portion of this policy, relevant to this EIS, is that relating to future growth. The three most pertinent objectives of this policy are moderating net in-migration into the state, encouraging economic growth in areas other than the Front Range, and minimizing urban sprawl.

Planning for air quality is the responsibility of the Air Pollution Control Commission and the Air Pollution Control Division (APCD) of the Colorado State Health Department. The APCD is in the process of developing an air quality maintenance plan for the Denver area. This work will be closely coordinated with other planning agencies through the policy bodies of these various agencies. Obviously, such cooperation is a necessary prerequisite for developing an implementable air quality attainment and maintenance plan, since it requires assumptions as to future population, land use and transportation modes.

The State Water Quality Control Commission is the central authority in all matters pertaining to water pollution control in the state and the Denver region. The Commission sets water quality standards and classifies waters of the state for various beneficial uses. The Water Quality Control Division of the Department of Health is the administrative arm for water pollution control activities. Their principal responsibilities include: state water quality planning, administration of discharge permits, enforcement of water quality regulations, and review of applications and plans for new wastewater treatment plants.

PUBLIC VIEWS OF ENVIRONMENTAL PROBLEMS

EPA executed a program of public information and involvement in connection with the publication of the draft of this EIS. An analysis and report was prepared of the views expressed by Denver region residents in response to that program (Reference 130). Following is the portion of that report which discusses what Denver region residents perceive as environmental problems.

Air Quality

Air quality is generally perceived as Denver's most severe environmental problem. Air and water pollution were indicated as the major regional problems in opinion surveys conducted by a Denver television station in the spring of 1973 and in the survey conducted in late 1973 for the United Bank of Denver. The latter survey found that 47 percent of the sampled population believed air quality to be a major problem facing the Denver region; younger respondents (25 to 34 years old) were more likely than other age groups to hold this view, while members of minority groups tended to find such problems as crime and the cost of living more severe than environmental problems. Nearly two-thirds of the respondents anticipated further deterioration in air quality over the succeeding five years.

The 1976 voter surveys also found air quality a major issue. The Denver Urban Observatory survey found 81 percent of the electorate believe air pollution a very serious (52 percent) or fairly serious (29 percent) problem; services for the elderly was the only other issue of as great concern. The Denver Metropolitan Study reported that a total of 57 percent of the voters find air pollution a very serious problem, which was the highest level of concern reported for any problem.

These opinions of a random sample of residents/voters are supported in EPA's workshop and newspaper questionnaires. Air quality was the topic on which most workshop participants (77 percent) expressed dissatisfaction. As far as the likely future effects of regional growth are concerned, citizens responding to the newspaper questionnaire found air quality a very significant growth impact, over 87 percent expressing that view, and about 40 percent found air quality the most important single impact of growth.

Water Quality

The public, as a whole, as based on random surveys of residents and voters, does not find water quality problems nearly as severe as air pollution. For example, sewage disposal was felt to be a very serious problem by only 18 percent of the respondents to the Denver Urban Observatory survey; water supply, on the other hand, was mentioned by 27 percent as a serious problem. In the Denver Metropolitan Study's survey (also 1976), the views reported were nearly parallel; on water supply, 35 percent felt there is a serious problem, while sewage disposal was recognized as a serious problem by 18 percent of the respondents.

In part of this low level of problem recognition stems from the survey's use of the narrow term "sewage disposal" rather than the broader term, "water quality". However, even those closely involved in water quality planning have not found attainment of clean water objectives as a high priority need. The participants in DRCOG's water quality meetings in five basins generally split on this issue with about a third finding clean water an issue of medium importance; about 31 percent found it of high importance and 37 percent of low importance.

Of the six major areas of environmental concern covered in EPA's newspaper questionnaire, water quality was considered the most important impact of growth by about 21 percent of the respondents. Water quality ranked second on this measure, well below the 39 percent who felt air quality would be the most serious impact of growth.

Just over half of the workshop participants expressed strong dissatisfaction with water quality problems, in the Denver region. However, some of the problems ranking lower in the scale of importance (energy and land use) prompted a higher proportion of responses of dissatisfaction with current programs. This means that, while water quality may be seen as a serious problem by a significant proportion of the public, other functional areas appear to the public to be less effectively addressed by current programs.

Land Use

Land use is the physical disposition of human activity. Land use decisions may relate to the type of use (residential, commercial, recreational, and so forth), the scale of the use (size and number of structures or operations) and how one use relates to other uses. In its most general definition, land use includes both open space and built space, and it includes transportation facilities as well as all the kinds of uses which would be destination points.

In the 1976 surveys of random samples of voters and residents, respondents were given a list of areas of government activity, and were asked to indicate which areas posed very serious problems; multiple answers were accepted. These "problem lists" included both planning and zoning with about one-fourth of the respondents selecting urban planning and one-fifth mentioning zoning. (These percentages cannot be added together because the respondents could select as many problem areas as they thought appropriate.)

The 1974 report by Bickert reports that a 1973 Junior League survey yielded similar results: about one-fifth of all local community leaders in the Denver region considered land use and zoning to be among the major problems facing the region.

EPA's survey responses broke land use into two categories, urban and agricultural. Dissatisfaction with urban land use programs in the region was higher (64 percent) than with agricultural (54 percent); both of these were higher than dissatisfaction with water quality programs (51 percent). Urban land use planning was considered by 20 percent of the newspaper questionnaire respondents to be the most important problem area faced by a growing Denver region, just slightly less than the 21 percent who found water quality the most important.

The EPA questionnaires did not list transportation separately from land use as a potential problem area. In the earlier opinion surveys, transportation and been mentioned by a large majority of the respondents as an area posing serious problems: 58 percent in the 1973 Junior League surveys, over 60 percent in one of the 1976 surveys. (The other 1976 survey offered as separate items on the problem list parking and traffic, 36 percent; public transportation, 27 percent; and streets and roads, 23 percent.

EPA's respondents, in their comments, frequently called attention to the relationship between transportation and environmental conditions. Most of the comments respondents made on the subject of transportation were in the context of air quality, with improvement of rapid transit and curtailment of auto use recurring recommendations. Many of the comments offered at the workshops and on their EPA questionnaires suggest that respondents considered the term "land use" to include transportation. For example:

> "We need better land use planning, particularly in relation to density, air quality and transportation."

The issue of agricultural land use was less stressed by EPA's respondents than the issue of urban land use, with less than 5 percent seeing the former as the most important problem facing the growing Denver region. Neither agricultural land nor open space in general had been included on the "problem lists" of the 1976 surveys.

Other Environmental Issues

The two 1976 opinion surveys asked for respondents' evaluations of two other environmental problem areas, and the proportions identifying those problems as "serious" were about the same in both surveys: Solid waste disposal, 16 percent and 17 percent; recreational programs and parks, 9 percent and 17 percent. Animal control is not wholly a matter of environmental concern, although animal waste is one factor in non-point source water pollution. Interestingly, animal control was considered a serious problem by 74 percent of the respondents in one of the 1976 surveys.

The EPA questionnaire solicited views on two other specified environmental issues, energy and recreation/open space. Neither of these areas received many mentions as the most important problem facing the Denver region in the future, although over 80 percent felt energy to be a very significant problem. Only half thought recreation/open space very significant; that was the lowest percentage of the problem areas listed.

In soliciting comments, EPA also offered respondents the opportunity to indicate other areas of environmental concern which had not been specifically listed on the questionnaire. While most of the comments, both on the workshop questionnaire and on the newspaper questionnaire, focused on the issues already discussed, other issues were also identified. There were many comments on the need for improved public information and education on environmental problems. Research on environmental problems was also advocated, as well as training in environmental administration and management. Other environment problems mentioned by three or more respondents were: water runoff (including drainage and flood control); water supply, conservation and reuse; noise; solid waste; and wildlife protection.

Both EPA's research and investigation by other researchers identified certain nonenvironmental problems as being of serious concern. Rising housing costs, services to the elderly and crime were among these; but if the variety and extent of environmental concerns expressed by the region's residents in all these studies are taken collectively, there appears to be a consensus that environmental problems constitute the major impediment to the enjoyment of the good life in Denver.

III. Proposed Projects and Alternatives

SECTION III

THE PROPOSED PROJECTS AND ALTERNATIVES

PROPOSED PROJECTS

This section of the EIS presents proposed and alternative approaches that have been examined for meeting regional water quality goals.

BACKGROUND

This EIS has been prepared simultaneously with the Clean Water Plan prepared under Section 208 of the Water Pollution Control Act Amendments of 1972 (P.L. 92-500). The Clean Water Plan is commonly referred to as the 208 plan, and was prepared by the Denver Regional Council of Governments (DRCOG), the region's 208 planning agency. The Clean Water Plan is concerned both with non-point sources of water pollution and with point sources. The Clean Water Plan and supporting Technical Report were approved with conditions and submitted to EPA for review by the State of Colorado in January 1978. Plans for controlling point sources of pollution from the region's municipal wastewater treatment plants are called "facility plans" or "201 plans", and are prepared under Section 201 of the Water Pollution Control Act Amendments of 1972.

The major non-point source of pollution in the Denver area is urban runoff. The study conducted during the preparation of the Clean Water Plan has identified the effect of urban runoff on instream water quality for each of the fifteen subbasins. The conclusion reached by the Clean Water Plan is that, even with adequate point source controls, non-point sources in the form or urban/agricultural runoff would probably prevent year-round achievement of desired water quality for all of the streams in the metropolitan area, except for the South Platte above Chatfield Dam. A detailed analysis was not undertaken for the Eastern Plains subbasin by the 208 study. As a result of this conclusion, the 208 study investigated the feasibility of implementing structural and non-structural control measures which would yield the desired water quality, stream segment by stream segment, throughout the urban study area.

The major point sources of water pollution in the Denver region are effluent flows from regional and subregional wastewater treatment plants. Two basic approaches are being considered for control of these sources. One approach would transport wastewater to a large regional plant; the other would involve the operation of several subregional and local satellite plants. The latter approach is presently favored by DRCOG because of the greater opportunity for reuse of the region's wastewater, and because it allows local control over water quality and allocation decisions. This preference is reflected in the point source recommendations of the Clean Water Plan.

Alternative and Preferred Non-Point Source Control Strategies

Basically, non-point sources consist of urban and rural stormwater runoff. The Clean Water Plan has estimated that non-point source control, which would result in the achievement of the 1983 water quality goals, would cost the region approximately 284 million dollars per year by 1983. The conclusion of the Clean Water Plan is that this cost is excessive for the "minor" improvement in water quality that would be expected.

About 50 percent of the 284 million dollars for non-point source controls would be structural controls designed to collect, store, treat and discharge stormwater. Therefore, a non-structural "program" approach to controlling non-point sources is being recommended by the Clean Water Plan. The goals of this approach would be to maintain and improve the quality of runoff in the region by, for example, such typical measures as improved street sweeping services, catch basin maintenance and leaf disposal. As part of this approach, the Clean Water Plan recommends that implementation of structural non-point controls be held in abeyance until specific problems can be pinpointed. The Clean Water Plan suggests that more monitoring of stream water quality is needed to make this assessment and that such a program should be completed in several years.

Alternative and Preferred Wastewater Treatment Facility Designs

The following sections summarize the major known features of the individual facility plans being collectively examined in this EIS. The description of each facility also includes a discussion summarizing the feasible alternatives from which the preferred design was selected, and a statement of reasons why the preferred design was considered superior. Planning areas for these facilities are shown on Map J. Table III-A presents lists of the facilities and their design flows, effluent standards and feasible alternatives based on best available information.

Table III-A. CURRENT FACILITY PLAN ALTERNATIVES
(*indicates plan recommendation)

Facility	Design flow, mgd.	Effluent Quality	Alternatives Considered			
South Adams plant expansion and interceptor sewers	6.0	BOD: 20 mg/l SS: 20 mg/l NH_3-N: winter, 3.0 mg/l, summer, 7.0 fecal coliform: 6000/100 ml residual Cl: 0.5 mg/l.	Alt. 4: primary sedimentation, existing trickling filters (2.5 mgd); 1978, add 1.75 mgd RBD without nitrification; 1983, add 4.25 mgd RBD nitrification; 1986, 1.75 mgd RBD with nitrification; sludge anaerobically digested, marketed. present worth: $7.29 million	Alt. 5: Same as Alt. 4 except nitrification by infiltration/percolation at site south and adjacent to plant. present worth: $7.08 million	Alt. 6: Same as Alt. 5 except infiltration percolation site located near I-76 and 96th avenue. present worth: $7.2 million	*Alt. 7: Same as Alt. 4 except nitrification by land application through discharge to O'Brien canal and Burlington Ditch. present worth: $6.64 million
Englewood/ Littleton advanced wastewater treatment plant	40	BOD: 20 mg/l SS: 20 mg/l NH_3-N: 3 mg/l fecal coliform: 1000/100 ml residual Cl: 0.01 mg/l.	Alt. 1: Reactivate Englewood plant and add ammonia and chlorine removal facilities at joint Englewood/Littleton plant by 1980. Expand joint plant to 30 mgd by 1982, and to 40 mgd by 1992. present worth: $35.6 million	Alt. 2: Same as Alt. 1 except Englewood plant not reactivated. present worth: $38.6 million	*Alt. 3: Same as Alt. 2 except ammonia and chlorine removal facilities not added until capacity expansion for 1982. present worth: $33.3 million	
South Lakewood plant expansion	3	BOD: 20 mg/l SS: 20 mg/l NH_3-N: 3 mg/l Fecal coliform: 1000/100 ml residual cl: 0.05 mg/l.	*Alt. 1: Improve and/or enlarge existing treatment plant to 3 mgd with biological nitrification in 1978. For flows from South Lakewood, Bonvue, Daniels and part of Lakewood; parallel some outfall sewers within these districts. Remainder of area flows to MDSDD #1. present worth: $3.95 million	Alt. 1A: Same as Alt. 1 except include flows from East Lakewood Sanitary District. present worth: $4 million	Alt. 3: Abandon existing plant; lay larger trunk sewer to connect to Metro District interceptor line (i.e., all flows to MDSDD #1 for treatment). present worth: $1.0 million	Alt. 5: Enlarge existing plant to serve entire area, construct AWT facilities and improved sludge handling facilities. Expand plant to 10 mgd by 1980. present worth: $16.9 million

Table III-A (Continued). CURRENT FACILITY PLAN ALTERNATIVES

Facility	Design flow mgd.	Effluent Quality	Alternatives Considered			
Cherry Creek and Goldsmith Gulch interceptor sewer	1985: 53 mgd, 2000: 85 mgd.	To be determined	Alt. 2: System of sewers to carry entire area flow to Northside plant; upper half parallels eastern bank of S. Platte River, lower half parallels existing Delgany main; no pumping station required.	Alt. 3: Same as Alt. 2, except sewers routed to east of downtown area rather than parallel to Cherry Creek outfall and eastern bank of S. Platte River.	Alt. 4: Same as Alt. 2, except flow routed directly to MDSDD #1 instead of Northside via Sand Creek.	*Alt. 5: Same as Alt. 2, except capacity based only on 1985 projected flow (49 mgd); additional future capacity provided by construction of Cherry Creek satellite plant and staged expansion of plant as required; plant effluent to be reused; 1985 design: 4 mgd, 2000; 16 mgd.
			present worth: $25.2 million	present worth: $26.2 million	present worth: $28.5 million	present worth: $25.9 million
Lower South Platte treatment plant and interceptor sewers	26 (including 6.0 SACWSD)	BOD: 20 mg/l SS: 20 mg/l NH_3-N: 3.0 mg/l fecal coliform: 1,000/100 ml residual Cl: 0.05 mg/l	Alt. 4: New plant at 164th Ave. and S. Platte River to treat flow from Brighton, Lower Thornton and 1st 2nd and 3rd creeks; flow from Upper Thornton and NWSWSD pumped to MDSDD #1 (1981 plant: 8.3 mgd, 1990 to MDSDD #1: 8.3 mgd, 2000 to SACWSD; 6 mgd); SACWSD to remain independent; effluent discharged.	Alt. 5: Same as Alt. 4 except flow from Lower Thornton also pumped to MDSDD #1 (1981 plant: 3.7 mgd, 1990 to MDSDD #1: 13.3 mgd); effluent discharged.	*Alt. 14: Same as Alt. 5, except flow from Lower Thornton pumped to Big Dry Creek Treatment Plant (City of Westminster) for treatment and agricultural exchange.	Alternative 4 has been designated the alternative recommended plan for purposes of predesign pending the resolution of institutional and management problems concerned with implementing Alt. 14.
			present worth: $25.1 million	present worth: $25.2 million	present worth: $24.4 million	

Table III-A (Continued). CURRENT FACILITY PLAN ALTERNATIVES

Facility	Design flow, mgd	Effluent Quality	Alternatives Considered			
Clear Creek	37	BOD: 20 mg/1 SS: 20 mg/1 NH_3-N: 3.0 mg/1 fecal coliform: 1,000/100 ml residual Cl: 0.05 mg/1	*Alt. 1: Parallel Clear Creek interceptor to transport all basin flow to MDSDD #1 for treatment. present worth: $15.6-20.8 million	Alt. 2: New plant near Youngfield St. and 40th Ave. to provide treatment through NH_3-N removal for flows from N. Table Mountain, Golden, Applewood and Pleasant View (air activated sludge; sludge anaerobically digested; drying bed; sold); 1983: 6.56 mgd; effluent for urban reuse; remainder transported to MDSDD #1 for treatment. present worth: $18.5-25.1 million		Alt. 5: Same as Alt. 2 except treatment by infiltration/percolation basins located near 44th Street and McIntyre. Note: Golden has proposed its flows be treated locally, by a new plant, for reuse present worth: $18.7-22.9 million
Sand Creek	42	BOD: 20 mg/1 SS: 20 mg/1 NH_3-N: 3.0 mg/1 fecal coliform: 1,000/100 ml residual Cl: 0.05 mg/1 Higher quality may be required for Alt. 3 and 4	Alt. 1: Parallel Sand Creek interceptor to transport flow from entire basin to MDSDD #1. present worth: $18.2-23.3 million	*Alt. 3: Expand existing Aurora plant from 1.5 mgd to 2 mgd for primary through advanced treatment for established flow volumes for urban, domestic, agricultural or industrial reuse, preferably domestic reuse in Quincy reservoir; remainder of flow to MDSDD #1 for treatment (40 mgd). present worth: $23.0 to 25.8 million	Alt. 4: Same as Alt. 3, except all flow from Sand Creek interceptor treated at expanded Aurora plant. Plant expansion to 17.2 mgd by 1981 and to 24 to 24 mgd by 1990. Remainder of flow to MDSDD #1 for treatment. present worth: $24.3 to 27.5 million	

Table III-A (Continued). CURRENT FACILITY PLAN ALTERNATIVES

Facility	Design flow, mgd,	Effluent Quality	Alternatives Considered		
Broomfield/ West-Minister regional treatment plant	9-16	208 proposed effluent limits, BOD: 20 mg/l SS: 20 mg/l NH_3-N: 1.0 mg/l Chlorine: 0.02 mg/l fecal coliform: 1000/100 ml For agricultural exchange, secondary treatment.	Primary Alternative: Expand Westminsters Big Dry Creek plant from 2.5 to 16.4 mgd to treat flows from Westminster (6 mgd), Broomfield (3 mgd) and Thornton and Northglenn (7.4 mgd). Westminster's portion of effluent for agricultural exchange with Farmer's Highline Canal during irrigation season, discharge to Big Dry Creek remainder of year. Thornton/Northglenn flows to use/ storage for agricultural exchange year round with Farmers Reservoirs and Irrigation	Secondary Alternative: Expand Westminster's Big Dry Creek plant from 2.5 mgd to 9 mgd to treat flows from Broomfield and Westminster. Agricultural exchange with Farmer's Highline Canal during irrigation season. Discharge to Big Dry Creek during remainder of year.	Facility plan started but work suspended pending coordination with Thornton, Northglenn, Broomfield and MDSDD #1 on Northglenn and Lower South Platte facility plans.
Northglenn	7	For discharges to Big Dry Creek, 208 proposed effluent limitations are BOD: 20 mg/l, fecal coliform: 1000/100 ml. For agricultural exchange, secondary level treatment.	Alt. I: All flows to Westminster's Big Dry Creek plant via new interceptors, pump stations and force mains for treatment and agricultural exchange. Bull Canal lined from Big Dry Creek headgate to new storage reservoir. This alternative is the same as recommended Alt. 14 of Lower South Platte.	*Alt. VII: Urban runoff from Northglenn collected in new reservoir and used, along with ground water, to supplement wastewater flows for agricultural exchanges. Force main from new Northglenn reservoir to Bull Canal reservoir in Weld County for pretreatment and storage of wastewater prior to agricultural reuse.	

Table III-A (Continued). CURRENT FACILITY PLAN ALTERNATIVES

Facility	Design flow, mgd.	Effluent Quality	Alternatives Considered			
			Facility plan.			
			present worth: $27.9-29.9 million ($11.4-18.5 including water supply benefits)	present worth: $24.0 million ($7.5 million including water supply benefits)	present worth: $22.7 million ($6.2 million including water supply benefits)	
Metro Denver Dewage Disposal District Plant #1	170-240	To be determined	Alt. 1: Treatment and discharge consideration will be given to various methods and levels of ammonia removal Discharge to the South Platte River.	Alt. 2: Land Application consideration will be given to irrigation, high-rate irrigation, overland flow, and infiltration/percolation	Alt. 3: Treatment consideration of domestic reuse by the Denver Water Board and successive use for irrigation via Burlington Ditch. These evaluations will also involve all pertinent water rights issues.	**Capacity needs in future dependent upon alternatives implemented for South Lakewood, Cherry Creek and Goldsmith Gulch, Clear Creek and Sand Creek.**

South Adams County Water and Sanitation District Service Area --

The South Adams County Water and Sanitation District (SACWSD) encompasses about 4,500 hectares (10,000 acres) of south Adams County and currently operates as an independent district. The present facilities consist of a 0.11 cubic metres per second (2.5 million gallons per day [mgd]) plant using primary sedimentation, followed by trickling filters. The sludge is anaerobically digested, dewatered on drying beds, and disposed of on land. The plant needs expanding and upgrading if it is to meet future effluent standards and to handle the service area's projected flow.

Two basic expansion and upgrading alternatives were considered. One was abandonment of the present plant, pumping all wastewater to the Metropolitan Denver Sewage Disposal District #1 plant (MDSDD #1). The other was expansion and upgrading of the current plant to handle future flows. The latter course was chosen (Alternative 7), with phased construction of a 0.08 cubic metres per second (1.75 mgd) expansion in 1978, and a 0.08 cubic metres per second (1.75 mgd) increase in capacity in 1986. This will provide a total plant capacity of 0.26 cubic metres per second (5.94 mgd). Plant effluent* will be pumped to the Burlington Ditch by 1983 for land treatment by agricultural irrigation. The first phase expansion is now under construction.

Englewood/Littleton Advanced Wastewater Treatment Plant --

The cities of Littleton and Englewood entered into a joint contract to build a treatment plant to handle the sewage from both cities. The new 0.88 cubic metre per second (20 mgd) capacity plant began operation in 1977 and is located adjacent to the present Englewood sewage treatment plant. The existing Englewood and Littleton plants have been mothballed.

Currently, a facilities plan is being prepared for advanced wastewater treatment at the joint plant. The plan considers ammonia and chlorine removal by various techniques, and the provision for capacity expansions to 1.31 cubic metres per second (30 mgd) by 1982, and 1.75 cubic metres per second (40 mgd) by 1992. Alternative 3 is currently preferred by the cities of Littleton and Englewood because of lower costs. However, ammonia and residual chlorine effluent limits would continue to be exceeded until 1982. Compliance by 1980 would occur under other alternatives.

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*Effluent is the term used to describe the discharged treated wastewater.

South Lakewood Service Area --

The Lakewood service area encompasses approximately 4,600 hectares (11,300 acres). The area is extensively developed, having a present population of about 68,000 and a maximum projected population of 80,000 to 85,000. The area is presently served by eleven sanitary districts of which only the South Lakewood District treats its wastes before discharge to the South Platte River. The existing treatment plant operated by the South Lakewood Sanitation District serves about 37 percent of the existing population, or 25,000 people. The remainder of the area flow is transported to and treated by the MDSDD #1 plant.

The facility plan for the area is complete and under EPA review. The plan focuses on four alternatives. All alternatives include nitrification in addition to secondary treatment prior to discharge to the South Platte River. The alternatives are either treatment of a portion of area flows in an upgraded plant, or treatment of all area flows possibly with a portion of the effluent being used for urban irrigation. The first alternative has been recommended.

Cherry Creek and Goldsmith Gulch Service Area --

Improvements to the wastewater collection system for the upper Cherry Creek service area are being planned and should be considered in conjunction with the proposed improvements to the Northside treatment plant. This area is under the limited jurisdiction of the Metropolitan Denver Sewage Disposal District #1 for planning treatment plant expansion.

Alternatives in the Cherry Creek and Goldsmith Gulch planning to date consider both the transport of all area flows to the Denver Northside/MDSDD #1 treatment complex, and the transport of some wastewater to the Northside complex with the remainder of the waste going to a satellite advanced wastewater treatment (AWT) plant to be constructed in 1985. (Wastewater from the AWT plant would be reclaimed through domestic, agricultural or industrial use, whichever is most feasible at the time.) The latter alternative has been recommended, Alternative 5, with the option of building the satellite plant in 1985 only if it is deemed feasible at the time. In lieu of a satellite plant, additional sewers could be constructed to the Northside plant. This alternative provides maximum flexibility, requires the lowest initial capital investment, provides for wastewater reuse and reduces future flow to the Northside/MDSDD #1 complex. The satellite plant would consist of secondary treatment, followed by tertiary treatment which would be applied only when effluent is discharged into Cherry Creek. Domestic reuse, industrial reuse and irrigation were suggested as possible options.

Lower South Platte Service Area --

The Lower South Platte basin occupies the western part of Adams County and lies generally northeast of metropolitan Denver. It is divided into nine subareas. The service area is administered by the MDSDD #1.

The facility plan originally considered 14 alternatives but narrowed these down to three for final consideration. All three call for a new wastewater treatment plant to be built at 164th Avenue and the South Platte River, and for the South Adams plant to be expanded and to continue operating as a separate district. The major differences in the three plans concern the amount of the area's waste to be treated at the new plant, how much is to be pumped to MDSDD #1, and whether or not any waste can be pumped to the City of Westminster's treatment plant in the Big Dry Creek Basin for treatment and agricultural use as part of a proposed water exchange with Farmer's High Line Canal and Reservoir Company. The selected alternative, Alternative 14, provides for treating the greater portion of the remaining area's waste by the new plant, with flows from lower Thornton going to the Westminster plant. The chosen alternative is considered comparible with Northglenn's successive use proposal. Alternative 4 was chosen as an alternative recommended plan for purposes of predesign because Alternative 14 poses management and institutional problems which must be resolved before it can be implemented. It was assumed for comparison purposes that the treatment plant would provide secondary treatment, with ammonia removal, sludge handling by anaerobic digestion, air drying and subsequent marketing. Agricultural use was not considered seriously because of its projected cost.

Sand Creek Service Area--

The Sand Creek Basin encompasses a large portion of Arapahoe County, smaller portions of Adams County and the City and County of Denver. It is divided in five subbasins, administered by MDSDD#1 except the Westerly Creek subbasin which is administered by the City and County of Denver. The flows within this subbasin are transported to a MDSDD #1 interceptor and plant for primary and secondary treatment.

The facility plan focused on basically two alternatives: Alternative 1 involves transport of all area wastewater flow to MDSDD #1 for treatment; Alternatives 3 and 4 involve advanced treatment of varying quantities of flow by a new plant and reuse of the water for domestic purposes. Since a large portion of the water currently received by the City of Aurora is "new" western-slope water, a portion of this water can be successively used by the City before discharge. This water would be treated and pumped to the Quincy Reservoir, a domestic raw water supply.

Alternative 3 was selected as the preferred alternative. This plan provides advanced treatment and reuse of a smaller portion of wastewater than under Alternative 4, but is significantly less expensive. It has several advantages over Alternative 1 by providing for reuse and successive use of water, reducing the amount of sewer construction along Sand Creek, and continuing the use of existing facilities. For purposes of comparison, the new treatment plant was assumed to provide secondary treatment with ammonia removal, sludge handling by anaerobic digestion, air drying, and subsequent marketing.

Clear Creek Service Area --

The Clear Creek planning area, which occupies portions of Jefferson and Adams Counties, lies generally northwest of metropolitan Denver and includes 11 subbasins. It is administered by the MDSDD #1. The facility plan selected two alternative approaches, one involving transport of all area wastes to MDSSD #1, the other involving treatment through ammonia removal of some of the area flow with successive use of the effluent, or treatment by infiltration/percolation basins. On the primary basis of costs, Alternative 1, the transport of all area wastes to MDSDD #1 was selected.

The cities of Golden and Arvada have protested the implementation of Alternative 1, transport of all flows to MDSDD #1 for treatment. Their concerns involve the foreclosure of options for successive use of wastewater derived fron nontributary water rights they hold.

Broomfield/Westminster Service Area --

This service area encompasses the cities of Broomfield, Westminster, and portions of Thornton. The City of Northglen is not included as it has selected an independent course of action. Existing facilities include a 0.16 cubic metres per second (3.6 mgd) plant operated by the City of Broomfield and a 0.05 cubic metres per second (1.25 mgd) plant operated by the City of Westminster. Both plants discharge into Big Dry Creek.

The Westminster plant is currently operating at or near capacity and an expansion to 0.11 cubic metres per second (2.5 mgd) is under construction to prevent the imminent pollution of Big Dry Creek. A facility plan is being prepared to consider further expansion of the plant. An expansion to 0.39 cubic metres per second (9 mgd) would provide adequate capacity to treat flows from Broomfield in excess of 0.16 cubic metres per second (3.6 mgd) as well as all other area flows. An expansion of up to 0.70 cubic metres per second (16 mgd) would accommodate additional flows from portions of Thornton and all of Northglenn.

A contract was signed in 1977 between the City of Westminster and the Farmer's High Line Canal Company for an exchange of water rights. Under this agreement, secondarily treated effluent will be discharged to the canal and used for irrigation of crops, and an equivalent amount of raw water will be diverted from the canal to Standley Lake, which is the city's municipal water supply (Reference 972). Under this exchange agreement, plant effluent would be used during the irrigation season, and discharged to Big Dry Creek the remainder of the year.

Northglenn --

In an effort to thwart the efforts of adjacent cities to condemn agricultural water for municipal purposes and to show that cooperation is superior to condemnation, the Northglenn City Council entered into an agreement in 1976 with the Farmers Reservoir and Irrigation Company Board of Directors which allows Northglenn to borrow water from Standley Lake, use it for municipal purposes, collect the sewage, treat the sewage, and store the winter flows for summer irrigation by farmers. Urban drainage, lawn irrigation return flow, deep well water and South Platte alluvial well water will also be collected, treated if required, and transported to a storage facility in such quantities as to return all of the borrowed water to the farmers plus provide a 10 percent "bonus".

Sewage from Northglenn would be treated after piping it to an aerated lagoon/storage reservoir in Weld County. A small catchment reservoir would be required for urban runoff control. The develop able areas of Thornton to the northeast are considered within this plan for possible inclusion at some time in the future.

The Northglenn facility plan, submitted for review, compares primarily Northglenn's proposals with Alternative 14 of the Lower South Platte facility plan, and recommends implementation of Northglenn's proposals.

Expansion of Metropolitan Denver Sewage Disposal District No. 1 Plant

An expansion of MDSDD #1's plant to include additional secondary treatment was completed in 1977, which increases the treatment capacity to 7.45 cubic metres per second (170 mgd). Ammonia removal facilities may have to be added to this plant by 1983. The addition of ammonia removal capacity could increase the plant capacity to approximately 8.32 cubic metres per second (190 mgd). No further capacity expansions are currently planned, but planning will depend upon actions taken on other facility plans.

The facility plan for additional treatment has not yet been prepared; however, the plan will consider three basic alternatives: treatment and discharge to the South Platte River; land application of effluent; and treatment and reuse. Under the treatment and discharge alternative, various methods of ammonia removal will be considered. Under the land application alternative, methods to be considered will include irrigation, high-rate irrigation, overland flow, and infiltration/percolation. Under the treatment and reuse alternative, consideration should be given to domestic reuse by the Denver Water Board and to successive use for irrigation via Burlington Ditch, including considerations of water rights issues.

The Clean Water Program's Recommended Plan for Municipal Wastewater Treatment Plants

Table III-B identifies the cost and effluent levels for the major facilities in the Denver Metropolitan Area, as estimated during the 208 Study. The costs are total capital costs for all aspects of municipal wastewater control through the year 2000.

EIS ALTERNATIVES - POINT SOURCES

In keeping with the regional overview of this EIS, three basic strategies were assembled from the various alternatives examined in completed and ongoing facility planning efforts. One of these strategies, no-action, is required by the National Environmental Policy Act. Each of these alternative strategies are assessed in subsequent sections of this report for their environmental impacts.

The three basic facility plan strategies addressed in this EIS are termed LOCAL, REGIONAL and NO ACTION. They are summarized in Table III-C. The extensive review of the draft EIS, where these strategies and impacts were first presented, by public agencies, special interest groups and individuals served to sharply focus several issues. These issues and their resolution are discussed in Volume 1, Sections III and IV of this EIS where the evolution of a final set of EPA actions is documented.

The Local Alternative

This alternative generally consists of the recommended alternatives of the completed facility plans, and the alternatives examining expansion and/or upgrading of treatment levels for existing wastewater treatment plants with facility plans now in progress. The exception is that the recommended alternative for the Clear Creek service area, a parallel interceptor to MDSDD #1 plant, is replaced by the alternative (2) calling for a new plant serving North Table Mountain, Applewood, Golden and Pleasant View, with the remainder served by interceptors to the MDSDD #1 plant. Figure III-A illustrates this alternative. This alternative closely resembles the recommendations of the Clean Water Plan.

Table III-B. CLEAN WATER PLAN RECOMMENDATIONS FOR MUNICIPAL WASTEWATER TREATMENT PLANTS

Facility	Cost[1] (Millions)	Effluent Requirement BOD (mg/1)	NH_3-N (mg/1)	Cl_2 (mg/1)	Fecal Coliforms (org/100 ml)
Littleton/Englewood	46.2	30	-	0.5	1,000
South Lakewood	1.3	30	-	0.5	1,000
MDSDD #1	42.5	30	-	0.5	1,000
South Adams County	7.9	30	-	0.5	1,000
Brighton	5.5	30	-	0.5	1,000
Glendale	1.6	30	-	0.5	1,000
Sand Creek	18.1	30	-	0.5	1,000
Golden	9.9	30	-	0.5	1,000
Big Dry Creek	36.4	20	1	0.02	1,000
Louisville	2.7	30	-	0.5	1,000
Lafayette	6.3	30	-	0.5	1,000
Erie	1.9	30	-	0.5	1,000
Boulder	19.3	20	1	0.02	200
Longmont	10.0	30	-	60.5	1,000

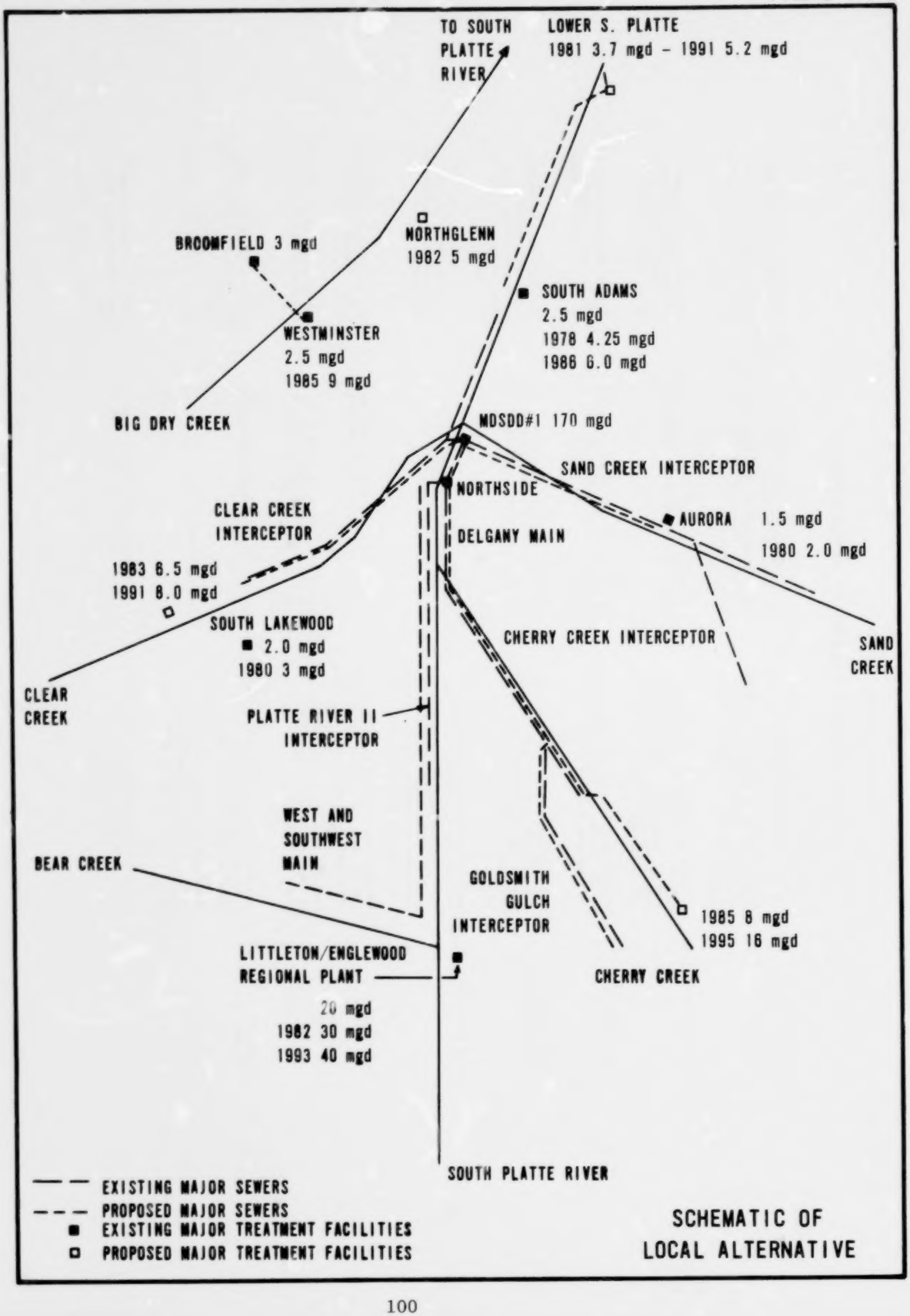
[1] These present worth costs reflect capital for facilities and interceptors through the year 2000.

Source: "Clean Water Plan" DRCOG July 1977

Table III-C. SUMMARY OF ALTERNATIVES

Service Area	Local Alternative	Regional Alternative	No-Action Alternative
South Adams	Maintain existing plant, add 1.75 mgd 1978, and final 1.75 mgd capacity addition in 1986 for a total capacity of 6 mgd.	Add 1.25 mgd activated sludge capacity in 1977, abandon plant in 1985, all flows to MDSDD #1.	Add 1.75 mgd capacity in 1978, final 1.75 mgd added in 1990.
Englewood/Littleton	Addition of ammonia and chlorine removal for 20 mgd capacity by 1979. Further expansion of joint plant to total capacity with AWT to 30 mgd in 1982 and 40 mgd in 1991.	Same as local alternative except flows over 20 mgd transported to MDSDD #1.	Addition of ammonia and chlorine removal delayed until 1982. Expansion to 30 mgd delayed to 1986.
South Lakewood	Enlarge existing plant, improve sludge handling facilities; capacity expanded from 2 mgd to 3 mgd.	Abandon existing plant and transport all flows to Northside/MDSDD #1 complex.	Maintain existing plant, and service area, transport effluent to Northside/MDSDD #1 complex.
Cherry Creek/ Goldsmith Gulch	System of interceptors to carry expected 1985 flow from upper Cherry Creek to Northside/MDSDD #1 complex. Provision for AWT satellite plant in 1985.	Same as local alternative except additional interceptors added in 1985 in lieu of AWT Cherry Creek satellite plant.	Same as local alternative except construction of interceptors delayed two years, plans for satellite plant abandoned.
Lower South Platte	New plant for flows from Brighton, 1st, 2nd and 3rd creeks. Flows from lower Thornton used by Northglenn in agricultural exchange. Remainder of area flows to MDSDD #1 and South Adams County Water Sanitary District.	All flows transported to MDSDD #1 except flows from Brighton, 1st, 2nd and 3rd creeks to new plant.	Same as local alternative except delayed four years, and lower Thornton flows to Westminster.
Clear Creek	New Plant with 6.5 mgd capacity in 1983 on Clear Creek. AWT for reuse. Additional flows to MDSDD #1.	Parallel Clear Creek interceptor to transport all basin flow to MDSDD #1 for treatment.	Same as regional alternative except delayed three years.
Sand Creek	Expansion of existing Aurora plant to 2 mgd with reuse. Remainder of flows to MDSDD #1.	Parallel Sand Creek Interceptor to transport flow from entire basin to MDSDD #1. Abandon existing Aurora plant.	Same as regional alternative except delayed three years.
Broomfield/ Westminster	Expansion of existing Big Dry Creek plant to 9 mgd by 1985 with land application/agriculture reuse.	Maintain existing plants with excess flow to MDSDD #1.	Expansion of existing Big Dry Creek plant from 2.5 mgd by 1985.
Northglenn	Flows to Bull Canal Reservoir for pretreatment and storage/use in agricultural exchange of 5 mgd by 1982.	All flows to MDSDD #1.	Same as regional alternative
MDSDD #1	Addition of ammonia removal for total plant capacity of 190 mgd by 1983. Option for reuse and successive use.	Plant expansion with ammonia removal for total capacity by 1990 of 260-270 mgd.	Addition of ammonia removal facilities delayed until 1985.

FIGURE III-A



SCHEMATIC OF LOCAL ALTERNATIVE

TO SOUTH PLATTE RIVER
LOWER S. PLATTE
1981 3.7 mgd - 1991 5.2 mgd
NORTHGLENN
1982 5 mgd
BROOMFIELD 3 mgd
SOUTH ADAMS
2.5 mgd
1978 4.25 mgd
1986 6.0 mgd
WESTMINSTER
2.5 mgd
1985 9 mgd
BIG DRY CREEK
MDSDD#1 170 mgd
SAND CREEK INTERCEPTOR
NORTHSIDE
CLEAR CREEK INTERCEPTOR
AURORA 1.5 mgd
1980 2.0 mgd
DELGANY MAIN
1983 6.5 mgd
1991 8.0 mgd
SOUTH LAKEWOOD
2.0 mgd
1980 3 mgd
CHERRY CREEK INTERCEPTOR
SAND CREEK
CLEAR CREEK
PLATTE RIVER II INTERCEPTOR
WEST AND SOUTHWEST MAIN
BEAR CREEK
GOLDSMITH GULCH INTERCEPTOR
1985 8 mgd
1995 16 mgd
LITTLETON/ENGLEWOOD REGIONAL PLANT
20 mgd
1982 30 mgd
1993 40 mgd
CHERRY CREEK
SOUTH PLATTE RIVER
EXISTING MAJOR SEWERS
PROPOSED MAJOR SEWERS
EXISTING MAJOR TREATMENT FACILITIES
PROPOSED MAJOR TREATMENT FACILITIES

The Regional Alternative

This alternative generally consists of alternatives examined in the completed and in-progress facility plans which call for centralized treatment at the Northside/MDSDD #1 treatment complex. Figure III-B illustrates this alternative.

The No-Action Alternative

This alternative assumes that no EPA grant funds for design and construction would be received by local agencies. As water quality standards would still have to be met, this alternative assumes that wastewater treatment facilities would still have to be constructed. Financing would be borne entirely by local agencies, primarily by the City and County of Denver and MDSDD #1, probably by some revenue bonds retired by user charges and connection fees. Some costs may be met through other revenue sources.

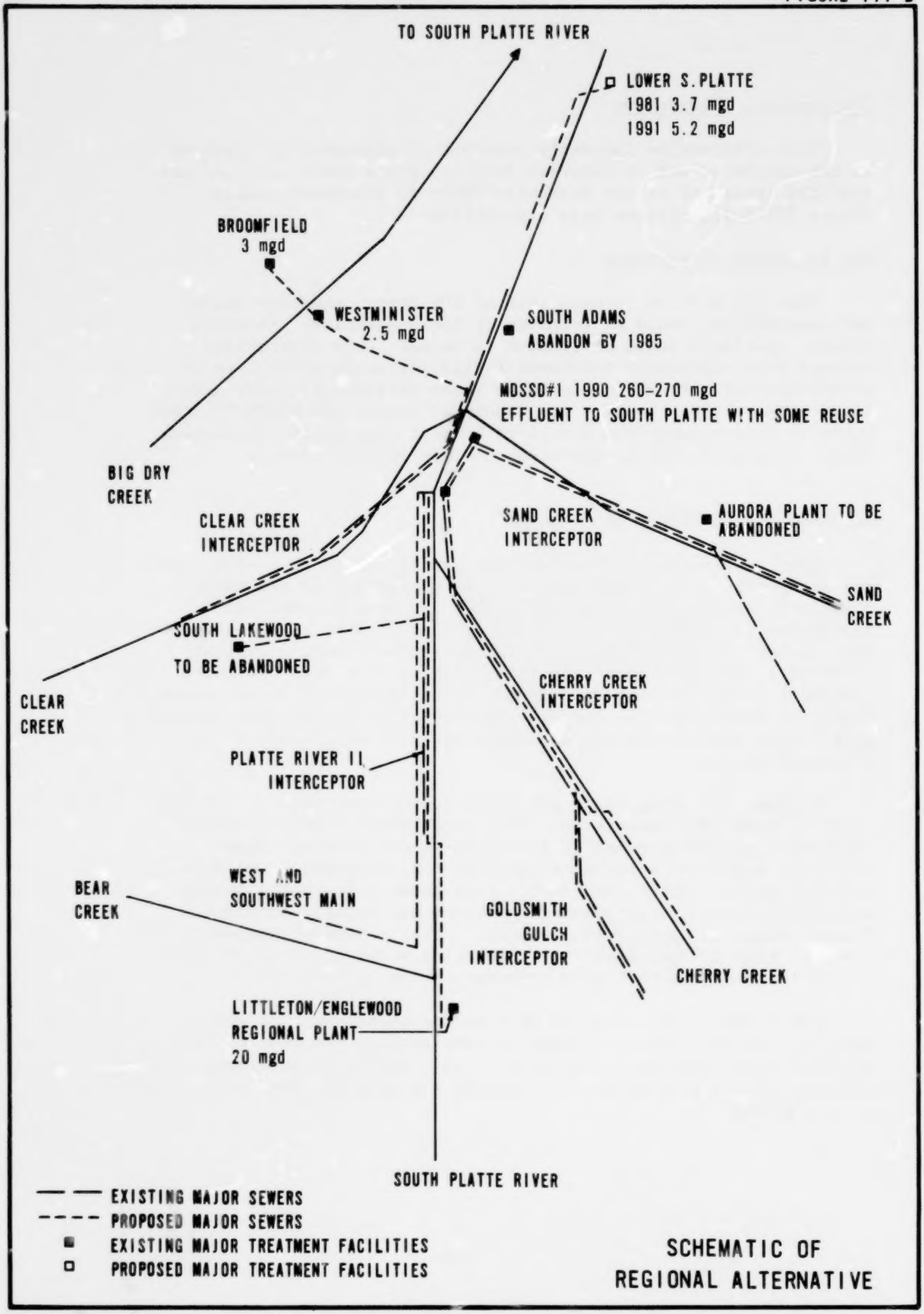
ALTERNATIVES TO STREAM DISCHARGE

Land application of wastewater effluent may be used with existing irrigation or by development of new irrigation on cropland, rangeland, or forested areas and parks. In general, two basic approaches are involved; ownership and operation of a land treatment system, or distribution of effluent to an existing agricultural or other operation. The latter system is a more realistic possibility for the eastern Colorado area. Excessive costs, water rights problems, and the complications of entering the agricultural market have made wastewater treatment agencies reluctant to use land application.

Systems involving reuse are being looked upon with increasing favor by Colorado communities. Some communities view wastewater reuse as a potential means of increasing their domestic water supplies, and/or as a means of avoiding the condemnation of agricultural water rights. Generally, only those communities owning nontributary (West Slope diversion) water are legally entitled to "reuse" water for their own purposes. Other potential systems, however, have the capability of increasing water supplies for municipalities using South Platte tributary water.

EPA's chief concern is protection and enhancement of water quality. If the potential reuse or land application systems have positive water quality benefits that would result in attainment of relevant stream standards, such systems are eligible for construction grant funding.

FIGURE III-B


TO SOUTH PLATTE RIVER
LOWER S.PLATTE
1981 3.7 mgd
1991 5.2 mgd
BROOMFIELD
3 mgd
WESTMINISTER
2.5 mgd
SOUTH ADAMS
ABANDON BY 1985
MDSSD#1 1990 260-270 mgd
EFFLUENT TO SOUTH PLATTE WITH SOME REUSE
BIG DRY
CREEK
CLEAR CREEK
INTERCEPTOR
SAND CREEK
INTERCEPTOR
AURORA PLANT TO BE
ABANDONED
SAND
CREEK
SOUTH LAKEWOOD
TO BE ABANDONED
CLEAR
CREEK
CHERRY CREEK
INTERCEPTOR
PLATTE RIVER II
INTERCEPTOR
BEAR
CREEK
WEST AND
SOUTHWEST MAIN
GOLDSMITH
GULCH
INTERCEPTOR
CHERRY CREEK
LITTLETON/ENGLEWOOD
REGIONAL PLANT
20 mgd
SOUTH PLATTE RIVER
EXISTING MAJOR SEWERS
PROPOSED MAJOR SEWERS
EXISTING MAJOR TREATMENT FACILITIES
PROPOSED MAJOR TREATMENT FACILITIES

SCHEMATIC OF
REGIONAL ALTERNATIVE

There are a number of ways wastewater reuse systems could operate. Most reuse systems proposed or in operation use one or a combination of four basic approaches. These are:

- Potable reuse: The direct reuse of wastewater effluent after special treatment for domestic purposes, including human consumption.

- Industrial reuse: The reuse of wastewater effluent for several industrial processes or cooling water after various degrees of treatment to suit each use.

- Urban irrigation: The irrigation of parks, golf courses, school yards, or boulevards with secondary treated wastewater.

- Agricultural reuse: The reuse of effluent for agricultural purposes after a certain degree of wastewater treatment.

According to Colorado water law, nontributary water to a basin can be completely reused; tributary water can be reused only if that reuse does not injure the rights of other users. Reuse of water tributary to the South Platte basin is usually accomplished through a water exchange agreement which avoids injury to the rights of other users. These exchange agreements, for example, exchange treated wastewater for water normally diverted for agricultural irrigation. This approach can be used to increase a municipality's water supply and may also result in a reduced effluent discharge to a stream. In-stream water quality may therefore be improved, but reduced flows in the stream may be detrimental to in stream uses.

All of the potential reuse schemes discussed are under consideration in the Metropolitan Denver Area. The water exchange and reuse arrangements are currently used at times by MDSDD #1 and the users of the adjacent Burlington Ditch. In addition, Westminster and Northglenn have proposed systems of the water-exchange type for increasing water supply. Recycling is being seriously considered by the Denver Water Board and the City of Aurora. Reuse for urban irrigation is now practiced by Aurora and South Lakewood, and Aurora is also considering the possibility of industrial reuse of effluent.

CLEAN WATER PLAN MANAGEMENT ALTERNATIVES

Section 208 of P.L. 92-500 requires that any plan prepared under its authority recommend management agencies which would be responsible for plan implementation. In response to this requirement, DRCOG in its draft Clean Water Plan, evaluated eight water quality "management" alternatives for point sources. They are:

1. General Purpose Governments
2. County Management Agencies.
3. Continuation of the Existing System.
4. Basin or Area Approach.
5. Regional Service Authority.
6. Metropolitan Council.
7. State-Oriented Approach.
8. Single-Purpose Agency Approach.

For non-point sources, the Clean Water Plan considered existing institutions only.

The State of Colorado generally prefers that general purpose governments be designated as management agencies in order to promote integration of planning for land use, non-point source control and future wastewater treatment facilities.

Point Sources

DRCOG has recommended for municipal point sources that all districts and municipal treatment agencies as of July 1, 1977, be designated management agencies. Exceptions to this are the cities of Longmont and Lyons, the Niwot Sanitation District, which will be included within the St. Vrain-Left Hand Conservancy District, and the Highland Park and Water and Sanitation District, which will be represented by the Supervisory Group of the Littleton/Englewood Management Agency. Single purpose collector agencies and treatment agencies with wastewater flows under 3,785 cubic metres (1 million gallons) per day are not being recommended for designation by the Clean Water Plan.

The DRCOG is concerned that the 34 agencies proposed for designation coordinate their future wastewater activities. Therefore, the Clean Water Plan is recommending that a Water Quality Advisory Committee be formed with representatives from each management agency and six others representing two other existing DRCOG water-related committees. The primary function of this coordinating group would be to set priorities for wastewater treatment projects within the regional planning area.

The Clean Water Plan has identified short-term and long-term goals for future consolidation of these management agencies. The short-term goals are: (1) to form immediately within each subbasin, a cooperative organization which consists of all the designated management agencies within that basin, and (2) at the end of five years, after approval of the initial Clean Water Plan, to have only one designated management agency per subbasin. The long-term goal is to establish a form of metropolitan governance which has enforcement and veto power, as well as responsibility for municipal wastewater management.

The Governor of the State of Colorado approved with conditions the DRCOG recommended Clean Water Plan in a January 10, 1978, letter to the EPA Region VIII Administrator. The DRCOG had recommended that fifteen municipalities and nineteen special districts be designated as water quality management agencies grouped into eight basin or area associations. The Governor concurred in the designation of municipalities, but designated only five special districts, four for a two year period. The state conditions also required that the management agency recommendations not concurred in be reevaluated within one year with the objective of strenghtening the role of general purpose governments including the counties. Two primary reasons for this condition are the capabilities of general purpose governments "to relate decisions between growth and development and associated services", and to "provide for coordinated management over both point and non-point sources".

Non-Point Sources

DRCOG Clean Water Plan recommended that no new agencies be designated at this time to have management responsibilities for the water quality aspects of non-point sources. This recommendation was based on the following factors: (1) non-point source problems were identified on a regional basis, but specific sources were not identified; (2) the logical agency for urban stormwater control, the Urban Drainage and Flood Control District (UD&FCD) does not have statutory authority for water quality; and (3) the UD&FCD was reluctant to assume responsibility for the water quality of urban runoff. DRCOG is suggesting that designation of non-point source management agencies be postponed pending further analysis of the specific non-point problems within the regional planning area.

The approval by the State of Colorado of DRCOG's recommended plan was conditioned to require the first annual update of the plan "to include a definition of the processes that are or will be followed in identifying and controlling non-point sources". The definition of processes "is to include the objectives, long and short-term remedial measures, management agencies and functions and possible regulatory controls".

IV. Probable Environmental Impacts

SECTION IV

PROBABLE ENVIRONMENTAL IMPACTS

The future of the Denver region will be shaped by the growth the region experiences in population, production of goods and services, and supportive facilities. The expansion of wastewater collection and treatment capacity affects the amount and distribution of growth in a region by increasing the supply of developable land. Because growth may generate significant secondary impacts in terms of the natural and social environment, this chapter begins with an examination of the region's likely future growth as the basis for facilities plans and the Clean Water Program.

SOCIO-ECONOMIC IMPACTS

Regional Population and Economic Impacts

Sources of Regional Growth--

The growth of a region starts with the creation of jobs serving markets outside of the region. Agriculture, manufacturing and military activity form part of Denver's export economy (basic demand). As people move into the region, jobs serving the local market are created in activities, such as retail trade, entertainment and construction (local demand). The number and diversity of firms serving the local market grow with the increase in basic demand and in population. The purchase of locally produced goods and services leads to continued production using local labor, land and capital. This results in additional locally produced goods and services. The creation of jobs in basic demand sectors provides the base for population growth, but population growth provides the labor force to fill the jobs and creates additional jobs serving the local market. Thus, population growth and economic growth become interdependent.

The relationship between job growth and economic growth is subject to a number of influences. One of these is imperfect labor mobility. Inadequate information about changing economic conditions results in a lag in response which may differ among age and skill groups in the labor force: the more mobile, highly educated segments of the labor force respond to such information more rapidly, while in-migration of the less educated and/or less skilled may be slower to taper off. Some in-migration may occur even in the face of adverse local economic conditions because the newcomer may be coming from a location where economic conditions are even worse. Interregional commuting may also affect migration. In-migrating newcomers to the labor force are primarily attracted to an area by job opportunities, either real or imagined, and not by social amenities. However, this is not to say that social amenities are not major factors in decisions to move to an area. It is simply an economic reality that for the aggregate of a labor force, job opportunities must exist before individuals can move to and remain in an area. In contrast to the labor force components of migration, there is a component of migration that is not predictable on the basis of economic factors. This migration component is made up of such groups as retired persons and students who move for reasons unrelated to employment. For these groups and others, such amenities as the relative attractiveness of the region may be the primary incentives to move there. Less desirable living environments are less likely to have a "growth problem" attributable to this migration component.

Economic Impacts of Growth--

The economic effects of growth are expressed in terms of the increase in the production of goods and services that provide people with satisfaction, and with the increases in jobs and income that are created in the production of these goods and services. Fiscal impacts - changes in the cost and quality of public goods and services - are a component of overall economic effects and are discussed separately below. Unlike fiscal or physical impacts, which are often confined to limited spatial areas or political jurisdictions, the effects of growth on the economy cannot adequately be analyzed in terms of local impact because growth in one locality will have economic effects that ripple outward through the region.

The benefits derived from the increase in the production of goods and services as a result of growth affect different interests in society depending upon their role within the regional economy. Table IV-A summarizes many of these effects. Consumers receive satisfaction from the increased choice, quantity, type and price of goods and services, such as agricultural products, housing, shopping and convenience goods items, personal services, repair services, entertainment and cultural functions, and outdoor recreational functions. Labor force members benefit from the increase in jobs to produce these good and services, and from the incomes thereby generated. Investors experience increased income benefits as a result of the production process, including incomes from the land values that are created. The profit potential of industrial and commercial interests benefits from economies of

Table IV-A. INCIDENCE OF THE ECONOMIC IMPACTS OF GROWTH GENERATED BY INCREASES IN THE PRODUCTION OF GOODS AND SERVICES

	Positive Impacts	Negative Impacts
Housing consumer	Greater number of housing options of different types and prices.	Increase in congestion as a result of the increase in size and complexity of area. Increase in dependence on neighbors and other members of society.
	Improved quality of housing units.	Difficulty in identifying consumer options.
Consumers of goods and services other than housing	Increased choice of goods and services available in terms of quantity, type and price.	Difficulty in identifying consumer options. Less independence.
Labor force members	Increase in job opportunities. Growth in real incomes.	Increase in competition for jobs. Increase in need for specialized training and experience. Increase in congestion and travel distances.
Capital investors and landowners	Growth of incomes.	Higher risks from increased competition, increased specialization and more rapid technological change.
Industrial and commercial interests and firms	Increases in profit through increases in productivity and lower costs resulting from: economies of scale, advantages of specialization, plentiful labor supply, readily available markets and ease of communication.	Higher risks and increases in failures as a result of more competition, difficulty in discerning market preference and sizes, increased specialization, and more rapid technological change.
Low income households	Labor force members: Job opportunities and real income growth. Greater choice in housing and consumer goods.	Same costs as identified above for consumers and labor force members.
	Retired: Slower increase in housing cost due to expanding supply. Increased value of local investments (if any).	Same costs as identified above for consumers.

scale, advantages of specialization, development of readily available markets within short distances and increases in the ease of communication.

While each type of participant is able to realize a different type of benefit, any one person or entity in society is likely to be able to realize several different types of economic benefits depending upon the roles in which he/she participates. The same is true of the costs of economic growth which arise as a result of the increasing specialization, complexity, size and scale of an urban area. People and firms become more dependent on each other since there are more of them in one area, they are more specialized, and they see each other and must interact more often and with more other people and firms. Choice creates opportunities, but may also increase risk. These negative aspects of economic growth are summarized in Table IV-A.

Evaluating the Economic Costs and Benefits of Growth--

It has been argued that, at some point, the economic advantages of growth are offset by economic disadvantages. Despite the intuitive evidence that from a social standpoint, large metropolitan areas are unpleasant, noisy, congested and timewasting, economic research has yet to find that any city in the United States has reached the point at which, in the aggregate, marginal economic costs of the combined public and private sectors exceed their marginal economic benefits (Reference 1000).

However, economic and population growth can assume an infinite variety of forms, the noneconomical impacts of which may significantly differ. These noneconomical impacts, whose costs often defy incorporation into quantified economic analyses, require policy approaches for assessment and resolution. Policy approaches available to cope with these noneconomic impacts include planning to accommodate anticipated growth in a manner so as to minimize marginal economic costs by the adoption of "no growth" or "slow growth" strategies. It should be pointed out that these non-accommodationist approaches cannot guarantee either the maintenance of present standards of living or environmental quality; "no growth" does not mean "no change." It must be emphasized that implementation of a no growth or slow growth objective limits or precludes the economic benefits to be derived from expansion and may alter the structure of the local or regional economy and the economic opportunities available to local residents.* The alternative available to a region's populace which wishes to avoid the adverse effects of "no growth" as well as "growth at any cost", is to identify and mitigate potentially deleterious environmental impacts of land use activities while guiding development toward the attainment of regional land use patterns which are environmentally sound.

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*By whatever means achieved, a restriction on the rate of population growth will have an impact on the number and type of employment opportunities (the demand for labor) and on the composition and size

Future Economic Growth in the Denver Region--

The Denver Regional Council of Governments (DRCOG) has forecast that employment in the five-county region will more than double during the period from 1970 to 2000, with total employment reaching a level of 1.13 million by the end of the century. Employment is expected to grow most rapidly during the initial portion of the forecast period (increasing 2.7 percent per year between 1975 and 1980) and level off toward the end of the period (increasing 1.8 percent per year between 1990 and 2000) (Reference 255).

The DRCOG forecast is based on projections of historic regional (1958 to 1975) total employment and employment by industry group; the results of the trend projection were adjusted in line with observations of the previous (1958 to 1965) effects of national growth, industry mix and regional influence on employment growth. Adjustments also were made to insure compatibility between employment and population projections. The industry-by-industry forecast is presented in Table IV-B; the table also includes a projection of the labor force participation rate.

The DRCOG forecast shows declining agricultural employment, which is consistent with agricultural land conversion estimates presented elsewhere in this chapter. All other sectors show significant increases with the service sector leading the way. Overall, the economy will continue to be oriented more toward the production of

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of the labor force (the supply of labor). A reduction in the growth rate will impact industries differentially depending on whether their level of operation is more closely related to the total size of the economy (for example, retail trade) or to the rate of economic expansion (on which the construction sector is primarily dependent). Costs of no-growth to individuals are therefore dependent on their investments and the economic sector(s) on which their livelihoods depend. Corollary to the earlier discussion in Sources of Regional Growth, regarding economic attractions for a labor force, is the empirical fact that reduced new job opportunities discourage in-migration and encourage out-migration, and out-migration normally affects the more highly skilled first, as discussed previously.

Table IV-B. SECTOR EMPLOYMENT FORECAST FOR THE DENVER REGION, 1975-2000

Industry Sector	Jobs in Thousands 1975	1980	1985	2000	% Change 1975-2000	% of Total Nonagricultural Employment, 2000
Agriculture	6.7	6.5	6.4	5.9	-11.9	----
Mining	7.8	8.3	8.9	11.0	+41.0	1.0
Construction	42.5	48.1	53.6	71.5	+68.2	6.4
Manufacturing	94.7	107.1	118.2	154.6	+63.3	13.7
Transportation, Communications and Utilities (TCU)	42.1	45.8	49.8	62.9	+49.4	5.6
Trade	161.6	185.5	206.8	275.6	+70.5	24.5
Finance, Insurance and Real Estate (FIRE)	44.9	52.1	58.4	78.2	+74.2	7.0
Services	143.4	167.0	188.0	260.6	+81.7	23.2
Government (including military)	124.4	142.8	158.6	210.2	+69.0	18.7
TOTAL	668.1	763.2	848.7	1130.5	+69.2	----
Labor Force Participation Rate (total employment ÷ total population)	.453	.462	.471	.481	-----	----

Source: Reference 255

goods, as was discussed in Section II. The sectors of mining, construction and manufacturing are forecast to decline slightly in terms of their collective share of total nonagricultural jobs, while increases in the service and FIRE (finance, insurance and real estate) sectors will come primarily from reductions in the share of manufacturing and TCU (transportation, communications and utilities).

The current DRCOG forecast has not been allocated to counties. Employment forecasting by DRCOG has considered distributions to urban service areas, and Table IV-C presents an estimate of what the distribution of forecast employment might be, given the county shares projected in the course of analysis (Reference 258 and 266). Figure IV-A shows the changing shares of county employment and population in 1976 and 2000. While Adams and Boulder Counties retain their relative shares of the total, and Arapahoe and Jefferson counties increase their share significantly, Denver's share is forecast to decline substantially.

. Future Population Growth in the Denver Region --

A year 2000 population forecast of 2.35 million has been adopted by DRCOG as the basis of all its planning activities. This "policy population forecast" incorporates elements both of regional policy and of forecasting. The antecedent of the forecasting element is an earlier forecast by DRCOG of 2.175 million in the year 2000; this forecast was based on (1) the continuation of the 1972 rate of net national increase (8.5 persons per 1,000 population annually) and (2) a gradual tapering off of net in-migration from the high levels (42,000 per year) of 1970-1973. (In the 1975-1980 period, net in-migration is forecast to be 15,700 annually, which was the 1960's rate; by 1980-2000, a further reduction to 15,100 annually is forecast, which was the average during the 1940-1970 period.)

This DRCOG staff forecast was reviewed by the Council, with Council members bringing to the consideration of this issue information from their local jurisdictions. After extensive discussion, the Council of Governments revised the staff forecast upward by 175,000 resulting in the 2.35 million total. The southeastern part of Jefferson County received the bulk of this addition. In January 1973 the amended total was adopted by DRCOG as regional policy.

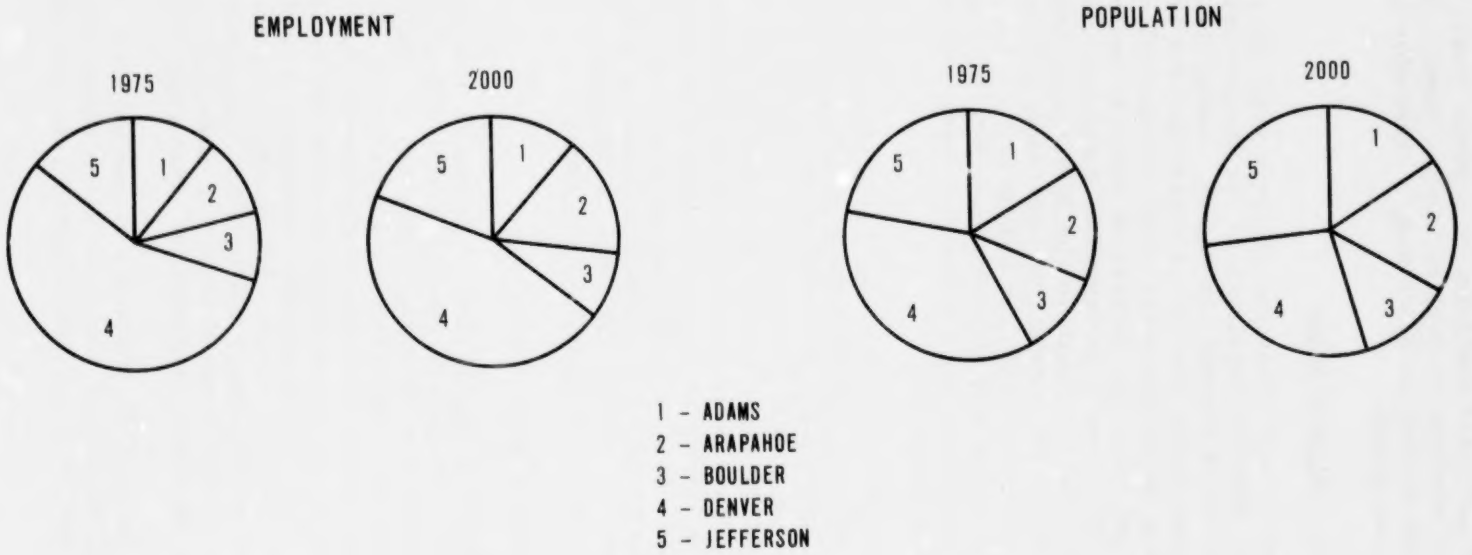
The net natural increase rates experienced in the last six years are within the range underlying the DRCOG forecast. Net natural increase declined from 8.5 per 1,000 in 1972 to 6.3 per 1,000 in 1974, but rose to 7.5 per 1,000 in 1976. Net in-migration has dropped from a 1972 high of 61,400 to about 16,000 per year in 1974 and 34,000 in 1976. The addition of 175,000 to the original forecast results in an implicit change in the forecast of in-migration, which would have to be 22,000 persons per year if the year 2000 forecast of 2.35 million is to be attained (Reference 993). Whether the net

Table IV-C. EMPLOYMENT PROJECTIONS FOR THE FIVE-COUNTY DENVER REGION

County	Current (1975) Employment	DRCOG Employment Forecast 1980	1985	2000
Adams	72,200	85,400	94,500	125,900
Arapahoe	68,400	86,100	106,500	175,800
Boulder	60,400	71,600	78,300	101,200
Denver	371,400	407,600	435,100	513,600
Jefferson	95,700	112,500	134,300	214,000
Total	668,100	763,200	848,700	1,130,500

Source: Totals from Reference 255; distribution to counties by Gruen Gruen & Associates based on Reference 258.

FIGURE IV-A



REGIONAL EMPLOYMENT
AND
POPULATION BY COUNTY

SOURCE: EMPLOYMENT ESTIMATES FROM TABLE IV-C
AND POPULATION ESTIMATES FROM REF. 231.

natural increase rate will stabilize at a lower level, or the net in-migration will continue to decline, is not known. However, the DRCOG forecast can be seen as describing a reasonable upper limit to regional population growth.

Community Services and Facilities

The increase in population and economic activity forecast to take place by the year 2000 has implications for the provision of public services and facilities through the region. Among the services which will face increased demand are sewage collection and treatment; water supply; fire and police protection; garbage collection and disposal; roads and other transportation services and public works projects; education; general governmental services; and parks and recreation. One study of growth in the Denver area found that, to serve an additional 1,000 persons, an additional 4.9 hectares (12 acres) of public institutional uses and parks, 5.3 hectares (13 acres) of streets, seven school classrooms, 570 cubic meters of water per day (150,000 gallons), two firemen and three policemen would have to be supplied (Reference 307).

The added community services and facilities will result in an increase in the costs of the government agencies which supply them. At the same time, new development will increase the local tax base. The fiscal impact of growth is individual to the service-providing entities; the regional fiscal impact of growth is only the aggregate of the local impacts, a point receiving further discussion in the next section. The investigation of the impacts of growth on public service requirements in the Denver region is part of the study program of the Denver Metro Environmental Analysis commissioned by the U.S. Department of Housing and Urban Development; whereas this study has not attempted to quantify these impacts.

Costs, Financing and Fiscal Impacts

The major fiscal issue related to growth is that of whether the provision of public services to new users will affect the quality or quantity of services to existing users, and of whether existing costs will be affected. The often-heard question of whether growth pays for itself is usually directed to the concern that the provision of public services to new users could increase the costs to all those paying taxes and user charges without increasing or improving the service outputs to existing users. For example, the Boulder Valley Comprehensive Plan establishes a policy that "new growth should bear the major expense of self-created needs for community services and facilities to the immediate neighborhood" (Reference 1012).

As shown in Table IV-D, there are circumstances in which the costs of providing additional public services exceed the revenue generated by the new users and new taxpayers, so that the net result

Table IV-D. INCIDENCE OF THE FISCAL IMPACTS OF GROWTH GENERATED BY AN INCREASE IN THE DEMAND FOR PUBLIC SERVICES

Interest or Actor	Benefit	Cost
Recipients of additional public service outputs (such as new residents).	Public service outputs.	Public taxes and user charges.
Existing taxpayers and existing recipients of public services in jurisdictions providing the additional public service outputs.	Reduced taxes and user charges if new users generate a net surplus of revenue over costs[a].	Increased taxes and user charges if new users generate a net deficit of costs over revenues[a].
Local municipalities and special purpose districts providing the additional service outputs.	A net fiscal surplus if revenues exceed costs.	A net fiscal deficit if costs exceed revenues.
Local municipalities and special purpose districts other than those providing the additional public service outputs.	Avoidance of service system expansion (if efficient levels of operation have been reached).	Failure to achieve efficient levels of operation (if now operating at lower than optimum rate of output).
Existing taxpayers and existing recipients of public services in jurisdiction other than those providing the additional public service outputs	Indirect benefits or costs depending upon which of the two conditions above apply.	

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[a] Circumstances under which these conditions would be experienced are discussed in the text.

of fiscal impact is an increase in costs to all users and taxpayers within the relevant public service jurisdiction.

It is not possible to generalize as to whether new development in the region will have a positive or negative fiscal impact on existing service users and taxpayers. The fiscal outcome is determined by five variables:

- the make-up of the existing population and development;
- the type of development experienced (scale, type and value of land used);
- the state of capital facilities in the relevant service districts at the time the demand for service increases (i.e., the presence or absence of unused capacity);
- the laws and policies concerning the types of taxes that are used to pay for the various kinds of public services; and
- the policies that the relevant service districts apply to the setting of tap fees and user charges.

COST CONSIDERATIONS

There are two factors which largely determine the impacts of growth on the cost of a particular public service. These are (1) the proportion of total costs represented by fixed or capital costs, and (2) the excess capacity of existing facilities.

A sewage treatment plant provides a service where a high proportion of total costs are fixed. Therefore, if the plant has excess capacity, the per unit cost (dollars per unit of wastewater treated) would decrease with population growth because fixed costs are spread over a larger base. However, if existing facilities are operating at capacity, new facilities would have to be built to accommodate additional population and per unit costs would go up.

For services with low fixed cost compared to total cost, an increase in demand is unlikely to increase per unit costs. Police protection and schools are examples of these kind of services. The per unit costs of these services are more affected by the quality of service demanded by a community than by population growth.

REVENUE CONSIDERATIONS

The net fiscal impact depends on the particular nature of the user charges and tax rates for generating service revenues as well as on the relationship between the revenues generated and the applicable set of costs, determined as discussed above. Many local public services are supported primarily by property taxes. While it is true that higher valued properties can generate higher tax revenues than can those of lower value, there is no property value level at which, as a rule of thumb, one could say that a net fiscal surplus will or will not result. It is the present and future mix of land uses - in terms of type and value - that determines net fiscal impact. There are differences among land use categories in terms of their demand for services and the revenues they generate. Industrial and commercial uses, for example, do not directly generate demand for educational services although they generate revenue to the school districts providing those services. Residential uses, on the other hand, do generate education costs; whether they also generate enough revenues to offset those costs depends on the value of the development and the number of school-age children it houses.

Net Fiscal Impacts and Land Use Planning

The type of growth a particular community experiences will influence its future service requirements and costs, and will determine its revenues as well. When viewed from a regional perspective, growth per se is likely to bring a mix of uses, including residential uses which provide housing for the workers in the industries and commercial establishments. "Less fiscally desirable" uses must go somewhere within the region if the "more fiscally desirable" ones are to continue to exist there. But, though a balance of uses may exist in the region as a whole, a local community may have a higher than average share of either type of development, depending on the community's location, market assets and the historic land use mix. An individual community may attempt to influence its fiscal condition by attracting "high value" development (such as major retail or industrial uses) and discouraging "low value" development (such as inexpensive housing with high demand for public education). This kind of fiscal rivalry can result in less efficient regional land use patterns.

On a local area basis, land use patterns can be planned to minimize the costs of providing government services. For example, higher density residential development may have lower per-unit road requirements and thus lower unit costs for roads; this results in lower unit costs for street lighting and street maintenance.

However, even where land use patterns are designed to minimize costs, this does not guarantee that revenues will exceed costs or, more important, that development in that location would be the least costly. Certainly, that development would not be least costly in the short run if it requires the construction of new facilities, while excess capacity for services exists elsewhere in the region at a location which the new use would accept.

While fiscal impacts are of importance to taxpayers and to public service users, public decision makers would be aware that fiscal impact is only part of a project's economic impact. Fiscal impact analysis considers only those costs and benefits which appear as cash flowing in and out of a particular local government treasury. It omits privately received costs and benefits as well as the interdependencies between types of land uses and among different public service jurisdictions. It also says nothing about the economic desirability of land uses. Thus, the question "does growth pay for itself" cannot be answered from the rather narrow perspective of fiscal impacts alone. A development with a negative fiscal impact may still be desirable, and a development which promises to be a local fiscal asset may nevertheless be undesirable. There are other impacts against which the fiscal impacts must be balance.

Impacts of Wastewater System Costs

The costs Denver communities will pay for wastewater facilities described elsewhere in this report are summarized in Table IV-E.

The Clean Water Plan has estimated the amount of capital expenditures through the year 2000 for municipal point source control at $672 million. Of this total, $319 million would be for treatment plant construction and interceptors, and $353 million would be for collection systems. Costs through 1985 for plants and interceptors would be $291 million, and for collection systems would be $113 million. Assuming that 75 percent of plant expenditures and 68 percent of interceptor cost would be paid by federal grants, $349 million of the $672 million total cost would be borne by local agencies and ultimately local citizens. These locally borne capital costs plus costs for operating and maintaining the systems results in an annual cost of $40.6 million in 1982 and $48.2 million in the year 2000 compared to an annual cost of $28.3 million in 1977.

Some portion of these costs will pay for expansion of wastewater treatment capacity, and these are the costs associated with growth. The remainder of the costs will finance changes in waste treatment operations to result in a treated waste product less damaging to the environment. This represents an increase in

Table IV-E. ESTIMATED AGGREGATE CAPITAL COSTS OF WASTEWATER FACILITIES ALTERNATIVES (MILLIONS OF 1977 DOLLARS THROUGH 1983)

Planning Area	Local	Regional	No-Action	% of Growth to 2000 Accommodated	Facility Plan Primary Objectives	
					Capacity	Improved Treatment
South Adams County	4.3	3.6	3.6	2.6%		X
Englewood/Littleton	14.6	3	1.6	22.4%[a]	X	X
South Lakewood	1.5	0.8	0.7	less than 1%		X
Cherry Creek - Goldsmith Gulch	12	12	8	2.3%	X	
Clear Creek	12	9.8	0	12.2%	X	X
Sand Creek	7	6.7	0.5	10 %	X	
Westminster/Bloomfield	4	5	4	9.9%	X	
Lower South Platte	5.8	4.4	1.0	6.3%	X	
Northglenn	18.5	2.0	2.0			X
MDSSD No. 1	14	17	14	b		X
Total Capital Cost	93.7	64.3	35.4[c]			
Local Agency Share	23.4	16.1	35.4			
EPA Grand Funds[d]	70.3	48.2	0			
Construction Employment						
Person-years	3,230	2,215	1,220			

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a. The new Littleton/Englewood joint plant is expected to accommodate growth till 1982 (20mgd).

b. MDSSD No. 1 would treat, under the local alternative, partial flows from Clear and Sand Creeks, flows from Cherry Creek/Goldsmith Gulch after primary treatment at the Denver Northside Plant, as well as flows from other areas not covered by listed planning areas. Capacity expansion completed in 1977. Further additions to capacity would be to accommodate growth.

c. Additional funds would be expended after 1982 because of deferred expenditures.

d. Actual amount of grant funds will depend on negotiations over eligible costs for each facility plan.

service quality (though it is being undertaken more in response to federal regulation than to local demand) and is therefore appropriately borne by native and new resident alike. The facility plans have not broken costs down by these two categories--system expansion and upgrading of treatment levels. The additional information on growth accommodation and facility plan objectives presented in Table IV-E provides a basis for making this type of determination. It must be kept in mind that other projects such as the Denver Northside and MDSDD #1 wastewater treatment complex expansion and the new Little/Englewood regional plant are now in operation. From the information presented in Table IV-E, it can be estimated that about one-half the total estimated cost for the next five to seven years is for growth accommodation.

The Clean Water Program study has estimated that approximately 64 percent of the total uninflated costs through the year 2000 are growth induced costs. In total dollars this would amount to about \$204 million out of the \$319 million projected for capital improvements excluding collection system, operation and maintenance costs.

The Clean Water Plan has projected an average 1985 per capita cost of about \$97 of which \$20 is for control of municipal point sources based on the 1985 projected population of 1.8 million people. Of the ten facility plans, only the South Lakewood plan presents per capita costs, \$16.94 for the recommended alternative.

The data presented in Table IV-E cover estimated costs of wastewater projects in the ten service areas. The South Adams County Water and Sanitation District has already received federal funds for Phase I of the current facilities plan. The plan presumed that 75 percent of the cost will be federally funded, with the local portion to be financed by the sale of bonds. The district meets all requirements for federal grant funds.

Englewood and Littleton have already received federal funds for construction of a jointly operated plant to provide treatment up to the secondary level and will probably apply for grants for future improvements to that plant. The cities are financially sound and appear to meet all requirements for federal grant-funding.

The City and County of Denver proposes additional interceptors in the Cherry Creek area. The only source of long-term debt financing available to City and County of Denver is revenue bonds of the Wastewater Management Division. The sale of revenue bonds must be approved by the City Council, as must any increases in user charges (Reference 225).

The Metropolitan Denver Sanitary Disposal District Number 1 (MDSDD #1) proposes future expansion of its main plant and upgraded treatment to be financed in part by state and federal grants and in part by the sale of revenue bonds (Reference 318). For MDSDD #1 to qualify for federal grant funds, all the user districts must conform to federal grant standards. Apparently not all conform at present, although recent amendments to the Clean Water Act may change this situation. This problem has caused delays in allocation of federal grant money in the past (Reference 225), and MDSDD #1 does not have any control over the means by which member districts raise revenues. The MDSDD #1 itself was authorized to issue some $30 million in revenue bonds, of which $20 million had been sold by 1973 for capital improvements currently being completed. This means that about $10 million worth of additional bonds can be issued without further voter approval. Beyond that amount, MDSDD #1 would have to obtain voter approval for a subsequent bond issue. It has been reported that there may be some resistance by district users to any further service charges or additional revenue bonds in the future (Reference 225). Given the likelihood of voter resistance to substantially increased charges, if federal grant funds are not forthcoming, it is unlikely that MDSDD #1 would be able to raise sufficient capital to pay for much more construction.

Future treatment plant expansion by the Cities of Broomfield and Westminster is proposed to be financed in part by federal grants. Both cities have received federal funds in the past, and both seem to meet requirements for future federal funding. However, if grant money were not made available, the cities would probably raise substantial capital by sale of more revenue bonds. The extent to which each city would be willing and able to sell these bonds is not known.

The South Lakewood Sanitation District (SLSD) intends to apply for a federal grant for expansion of its treatment plant and upgrading of treatment to meet July 1977 standards. A facility plan is currently being prepared for these improvements. In case the SLSD's reliance and property tax revenue proves unacceptable for federal funding purposes, discontinuation of ad valorem taxation would be considered.

The City of Northglenn's plan to use treated wastewater and urban runoff in a exchange for agricultural water is to be financed in part by federal grant funds, and in part by a $31 million general obligation bond issue approved by voters in 1977. Northglenn's proposal presents certain policy issues regarding which portions of the proposed system will be eligible for federal grant funds. These policy issues cannot be resolved by EPA Region VIII alone.

Estimates of effects of the costs of proposed facilities on such things as user charges and tap fees are not available. Increases will occur; their magnitude is not as yet known. Some estimates will bear the majority of the capital costs of new facilities. Over a twenty-five year period and a net growth rate of about two percent, 55 to 60 percent of the cost of new facilities would be borne by new residents. At a higher growth rate of four percent, the cost percentage increases to a range of 65 to 70 percent.

LAND USE CHANGE TO THE YEAR 2000

Between 1960 and 1970, the Denver region experienced an acceleration in suburbanization as the City and County of Denver became less dominant in terms of population concentration, though it continued to be the region's main job center. In the late 1960's and especially in the first part of the 1970's, employment has also become more widely dispersed through the region, with the City and County of Denver accounting for a declining share of regional employment. These changes have been accompanied by changes in land use patterns, with the suburban counties (Adams, Arapahoe, Boulder and Jefferson) experiencing increases in developed areas and losses in agricultural and vacant areas. These kinds of changes are unique neither to the 1960's nor to Denver: the pattern is common throughout the country, and it has every likelihood of continuing in the Denver region through the end of the century.

Future Land Use Change

In tabulating land use data, eight use categories have been established, and DRCOG has projected areas in each use by census tract as a function of future population and employment. This tabulation, aggregated by county, is presented in Table IV-F.

In reviewing the land use projections, the reader should keep several factors in mind. First, the data does not cover the five counties in their entirety, but only the portions which form part of the Denver Metropolitan Area. Thus, eastern Adams and Arapahoe, western Boulder and Jefferson Counties have not been included in the tabulation. Second, the boundary delineating the Denver Metropolitan Area for the purpose of land use tabulation was changed by DRCOG after the 1960-1970 tabulation. The redefinition resulted in the exclusion from the study area of large blocks of land in Adams, Arapahoe and Boulder counties. In Table IV-F, the figures for 1970 have been reduced by appropriate amounts in the relevant categories (generally agricultural, undevelopable and other vacant) so that figures for 1970 and 2000 cover the same area, but the total area figures differ from those in Table II-N. Finally, the land use projections of DRCOG are from the fourth-cycle runs of the EMPIRIC land

Table IV-F. COUNTY LAND USE SUMMARY, 1970 and 2000

County and Year	Residential		Commercial	Services	Industrial, Transportation Communications[a]	Parks and Recreation	Public and Semi-Public	Agriculture, Undevelopable and Other Vacant	Total
	Single-family	Multi-family							
Adams[b]									
1970	9,249	888	956	145	12,268	1,151	18,591	103,292	
2000	20,547	2,481	1,825	306	16,392	2,439	19,878	82,672	146,540
Change	11,298	1,593	869	161	4,124	1,288	1,287	-20,620	
Arapshoe[b]									
1970	8,498	519	595	254	7,115	2,951	4,662	66,169	
2000	18,456	1,532	1,498	527	12,589	4,054	7,128	44,979	90,763
Change	9,958	1,013	903	273	5,474	1,103	2,466	-21,190	
Boulder[b]									
1970	9,427	946	892	153	8,251	6,726	1,956	135,949	
2000	17,000	2,358	1,697	332	13,471	6,919	2,967	119,556	164,300
Change	7,573	1,412	805	179	5,220	193	1,011	-16,393	
Denver									
1970	21,505	3,296	1,975	720	28,687	6,102	4,382	25,336	
2000	23,167	4,254	3,019	788	32,761	6,578	5,088	16,348	92,003
Change	1,662	958	1,044	68	4,074	476	706	-8,988	
Jefferson[b]									
1970	15,020	838	1,174	966	15,430	1,754	5,928	93,011	
2000	26,684	2,300	1,983	1,146	20,348	3,074	6,352	72,234	134,121
Change	11,664	1,462	809	180	4,918	1,320	424	-20,777	
Total[b]									
1970	63,699	6,487	5,592	2,238	71,751	18,684	35,519	423,757	
2000	105,854	12,925	10,022	3,099	95,561	23,064	41,413	335,789	627,727
Change	42,155	6,438	4,430	861	23,810	4,380	5,894	-87,968	

[a] Includes streets

[b] Excludes portions of these counties lying outside Denver metropolitan region as defined by DRCOG (Reference 257).

Source: Acreage for 1970 from Reference 205 and for 2000 from Reference 257; figures for both years aggregated on the basis of 1970 census tracts as described by DRCOG (Mugler, pers. comm., February 10, 1977).

use forecasting model, which preceded the adoption of subarea population projections. Notwithstanding this limitation, however, much can be learned from the land use projections about the future pattern of land development in the Denver region.

All categories of developed land show substantial area increases over the 30-year period. The largest percentage increase is in multi-family residential area, which is projected to double by the year 2000. Single-family residential area will increase by about two-thirds, and commercial area by almost 80 percent. Land use in all other categories is projected to increase by at least 15 percent with the exception of undeveloped (the category headed agriculture, undevelopable and other vacant) which is projected to decline by about 21 percent.

Regional Development Patterns

The data presented in Table IV-G offer another way to consider future land use change in the Denver region: the percentage of total regional land in a given use category, represented by each county's land in that category, is listed for both 1970 and 2000. These data offer an indication of changes in the roles played by the counties in the regional context. The last row shows the percentage of land in each county which was classified as developed in the years 1970 and 2000. The most striking change between 1970 and 2000 is the increase in the percentage of developed land. In Adams, Arapahoe and Jefferson counties, the degree of urbanization in 2000 as indicated by this measure will equal or exceed that of Denver. Only Boulder County is projected to retain a comparatively rural development pattern, with less than 23 percent of its land developed. Even though Boulder is projected to lose 6,475 hectares (16,000 acres) of undeveloped land to development over the 30-year period, it will have a slightly higher proportion of the region's undeveloped land in 2000 (35.6 percent) than it had in 1970 (32.1 percent).

In the year 2000, the City and County of Denver will have a reduced share of regional developed land in all categories, as shown in Table IV-G; Denver's actual acreage increases, shown in Table IV-F, are small compared to those of the other counties. Jefferson County will become more "suburban" than it was in 1970: residential use will rise by over 80 percent, while land use for employment activities (commercial, services, industrial, transportation and communications) is projected to grow only 34 percent.

Future land use is shown on Map I. This future land use map was developed by DRCOG, and was based upon population and land use computer projections which have since been superseded as previously discussed. Figure IV-B shows a more recent DRCOG forecast of future urban service area boundaries within which extensions to urban

Table IV-G. PERCENTAGE DISTRIBUTION OF LAND BY USE CATEGORY, 1970 and 2000

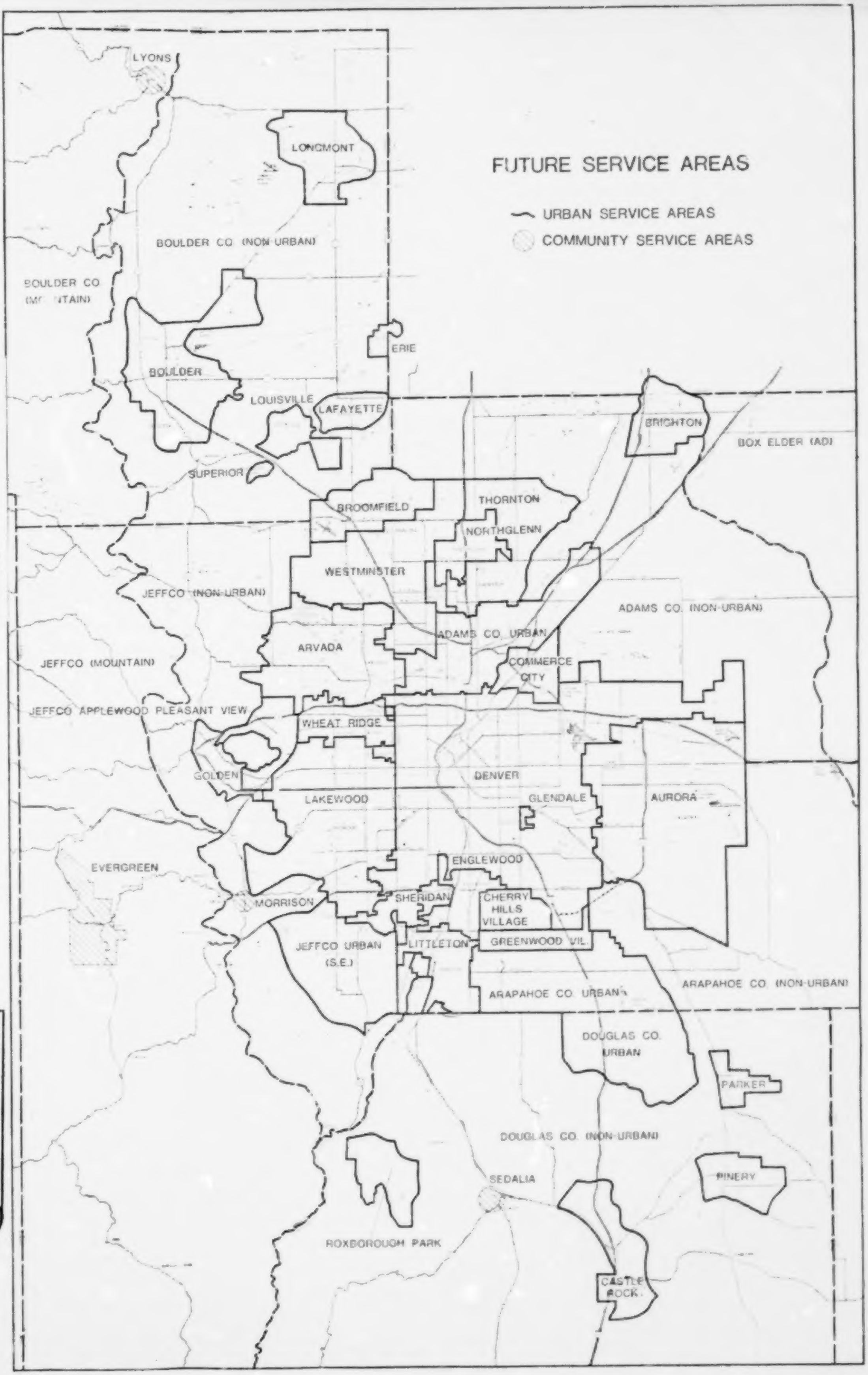
Land use category	Adams 1970	Adams 2000	Arapahoe 1970	Arapahoe 2000	Boulder 1970	Boulder 2000	Denver 1970	Denver 2000	Jefferson 1970	Jefferson 2000	Total Land by Land Use Category 1970	Total Land by Land Use Category 2000
Residential	14.4[a]	19.4	12.8	16.8	14.8	16.3	35.3	23.1	22.6	24.4	11.2	18.9
Commercial and Service	14.1	16.2	10.8	15.4	13.3	15.5	34.4	29.0	27.3	23.8	1.2	2.1
Industrial, Transportation, Communications	17.1	17.1	9.9	13.2	11.5	14.1	40.0	34.3	21.5	21.3	11.4	15.2
Parks, Recreation, Public and semi-public	36.4	34.6	14.0	17.3	16.0	15.3	19.3	18.1	14.2	14.6	8.6	10.3
Agriculture, Undevelopable, Other Vacant	24.4	24.6	15.6	13.4	32.1	35.6	6.0	4.9	21.9	21.5	67.5	53.5
% of Land Developed[b]	28.7	41.9	23.8	46.0	13.2	23.0	36.9	42.0	29.3	43.9	29.5	42.8

[a] Represents county share of regional total for specified land use.

[b] Includes all categories except (1) parks and recreation and (2) agricultural, undevelopable and other vacant, and represents percentage of land developed in each county.

Source: Table IV-F.

FIGURE IV-B



FUTURE SERVICE AREAS

URBAN SERVICE AREAS
COMMUNITY SERVICE AREAS
LYONS
LONGMONT
BOULDER CO. (NON-URBAN)
BOULDER CO. (MOUNTAIN)
ERIE
BOULDER
LOUISVILLE
LAFAYETTE
BRIGHTON
BOX ELDER (AD)
SUPERIOR
BROOMFIELD
THORNTON
NORTHGLENN
WESTMINSTER
JEFFCO (NON-URBAN)
ADAMS CO. (NON-URBAN)
ADAMS CO. URBAN
ARVADA
JEFFCO (MOUNTAIN)
COMMERCE CITY
JEFFCO APPLEWOOD PLEASANT VIEW
WHEAT RIDGE
GOLDEN
DENVER
LAKEWOOD
GLENDALE
AURORA
ENGLEWOOD
EVERGREEN
MORRISON
SHERIDAN
CHERRY HILLS VILLAGE
JEFFCO URBAN (S.E.)
LITTLETON
GREENWOOD VIL.
ARAPAHOE CO. URBAN
ARAPAHOE CO. (NON-URBAN)
DOUGLAS CO. URBAN
PARKER
DOUGLAS CO. (NON-URBAN)
SEDALIA
PINERY
ROXBOROUGH PARK
CASTLE ROCK

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services, e.g. sewers would be expected to be confined until the year 2000. Map I and Figure IV-B, nevertheless are useful in illustrating where future growth is expected to occur. Map I should be compared to Map H, and Figure IV-B should be compared to Map B. Map I incorporates certain planning policies which diminishes its relationship to the real world. As an example, the future land use shown excludes from floodplains and streamside areas development that is clearly known and shown to currently exist on Map H of current land use. Thus Map I shows not expected land use, but desired land use given certain development policies.

The projections imply some changes in the density of new development over the 30-year period. In 1970, there were about 42 persons per hectare (17 persons per acre) of land in residential use; in 2000, the projections indicate about 49 persons per hectare (20 persons per acre). This means that new development would be somewhat more dense than residential development in 1970, with about 57 persons per hectare (23 persons per acre) being the average density of new development. Employment uses are also projected to be more densely developed in the future, rising from about 1.7 employees per hectare (0.7 employee per acre) of employment land (which includes commercial, services, industrial, transportation and communications) to about 2.5 employees per hectare (one employee per acre) in 2000. (These estimates understate actual employee density because street acreage figures are included in employment land use. However, that does not affect the direction of change.)

The projections of land in park and recreation use indicate an increase of over 1.6 million hectares (4 million acres) by the year 2000, an increase of 23 percent over the 1970 acreage. However, residential development and population growth are projected to exceed that rate of increase. This means that park acreage per capita is projected to decline by 35 percent, from 6.2 hectares (15.2 acres) per 1000 persons to 4.0 hectares (9.8 acres) per 1000 persons, between 1970 and 2000. Although regional open space particularly outside the urban areas will be ample, opportunities for active recreation in the urban areas will be significantly diminished. Even without an increase in recreational demand, recreation areas will be more intensely used and degraded.

Regional Planning Issues

Land use patterns and environmental quality are intimately related. The magnitude, location, rate and spatial distribution of new development has important effects on the provision of public and private services, on environmental pollution and on the preservation of stable ecosystems. Elsewhere in this report the impacts of Denver's future growth on the natural environment (air quality, water quality, ecosystems and production of food and fiber) are described. In this section, the efforts of local and regional agencies to guide development so as to minimize its adverse environmental effects are reviewed. State policies were enumerated in early 1976 by Governor Lamm and planning policies of the Denver Regional Council of Governments were adopted in 1974. Within the context of these policies, possible steps to improve the effectiveness of local and regional planning are discussed, particularly with regard to wastewater facilities planning.

Efficiency of Future Development Patterns --

Recent literature in planning and urban geography has reported on a number of studies of the relationship between the spatial configuration of land development and its environmental consequences. These studies typically have found that major land uses have different environmental effects, depending on the pattern of development, and that a pattern of land development which includes dense concentrations of mutally supportive, interacting land uses offers important advantages not offered by dispersed development patterns.

The environmental effects of densely concentrated activity are often readily apparent. The demand for utilities and energy at a site of concentrated activity is high; traffic volumes result in congestion, noise and concentrated emissions; high percentages of impervious surfaces result in microclimatic changes, reductions in ground water recharge capabilities and possible increased problems in accommodating stormwater runoff. However, these direct effects may be the same whether the uses are concentrated or freestanding; the concentration of activities draws our attention to these impacts but does not necessarily increase the magnitude of impacts. In fact, the indirect effects of concentration may result in superior environmental impacts, both in reducing environmental degradation below that which would result from dispersed patterns of development and in providing improved economic opportunities. Beneficial effects of concentrating land uses in "activity centers" include (1) expansion of consumer choice by providing desirable residential locations for those to whom high density living is appealing, (2) increasing potential income to firms and individuals due to gains in efficiency in communication and exchange of goods made possible by proximate locations of activities, and (3) reduction in the indirect effects of development on the environment by making walking and collective forms of transportation reasonable alternatives to the automobile.

The activity center concept is a key element in the year 2000 plan for the Denver region, and a number of areas have been designated as activity centers or corridors; these are listed in Table IV-H. These areas are not yet fully developed (compare current population and employment to year 2000 population and employment), but the development of a complex interaction of densely concentrated land uses at these sites, supportive of higher density living and public transportation service, is the objective.

Table IV-H. REGIONAL SUBAREA POPULATION ALLOCATION BY SERVICE AREA (1977)

Service Area	1975	Short-Term 1985	Long-Term 2000
Mountain	29,600	41,600	53,800
Boulder Co Mtn	5,900	9,100	9,400
Evergreen*	7,800	12,000	16,800
Jefferson Co Mtn	14,200	18,800	25,300
Morrison	500	600	800
Nederland*	700	1,100	1,500
Plains	4,400	8,800	11,400
Bennett*	900	1,400	2,000
Box Elder (Ad)	400	1,400	1,800
Box Elder (Ar)	400	500	600
Byers*	400	1,500	1,800
Deer Trail*	400	700	700
East Plains (Ad)	200	600	600
East Plains (Ar)	700	900	900
Strasburg*	1,000	1,800	3,000
Valley	1,439,800	1,783,700	2,284,800
Adams Co (Uninc)	10,500	12,500	18,000
Adams Co (Urban)	62,500	65,500	80,000
Arap Co (Uninc)	700	6,600	19,500
Arap Co (Urban)	35,900	61,200	73,500
Arvada	80,800	100,400	125,000
Aurora	121,700	161,500	239,100
Boulder City	92,200	102,100	135,100
Boulder Co(E Uninc)	13,300	21,500	25,000
Bow Mar	1,100	1,300	1,300
Brighton	12,900	18,000	25,000
Broomfield	16,400	29,900	49,600
Valley (Cont'd)			
Cherry Hills Village	5,400	6,000	7,100
Columbine Valley	600	600	600
Commerce City	18,600	18,000	20,000
Denver	532,300	552,300	603,700
Edgewater	5,500	5,300	5,900
Englewood	35,900	40,900	45,900
Erie**	100	200	500
Federal Heights	7,600	9,600	12,200
Glendale	3,700	8,700	8,700
Golden	14,500	17,600	26,000
Greenwood Village	3,500	8,500	14,900
Jefferson (A-P)***	9,500	11,600	15,200
Jefferson (SE Urban)	21,200	59,700	111,700
Jefferson (Uninc)	200	4,800	12,000
Lafayette	5,800	10,200	14,000
Lakewood	123,000	163,600	220,100
Lakeside	****	****	****
Littleton	33,500	35,400	45,600
Longmont	34,200	51,400	74,200
Louisville	3,700	10,000	13,600
Lyons	1,000	1,600	2,500
Mountain View	800	800	800
Northglenn	31,500	38,500	40,600
Sheridan	6,000	6,900	11,400
Superior	300	400	500
Thornton	27,600	42,500	61,400
Westminister	31,600	59,500	80,300
Wheat Ridge	34,300	38,500	44,000
5-County Region	1,473,800	1,834,100	2,350,000

* Community Service Area.

** Allocation for part in Boulder County only.

*** A-P - Applewood - Pleasantview.

**** Less than 50.

The objective of encouraging a more efficient land use pattern by encouraging activity center development faces a number of impediments. First, the local jurisdictions with direct land use planning responsibility implement it unevenly. Arapahoe County is an example of one jurisdiction which plans to work toward high density levels along designated travel corridors, in part in the hope that rail rapid transit service will eventually be provided (higher density development may indeed be a precondition for it). Other communities recognize advantages in higher density housing that are economic as well as environmental: lower land costs per unit put the higher density unit in the reach of more households; smaller units are appropriate in a period of declining household size and declining real incomes; and densely concentrated development typically has lower public service costs per unit. But proposals for dense residential development often meet public opposition, with blockage of views, interruption of scenic corridors and changes in community character given as reasons for public objections. With the majority, especially of the suburban public, lukewarm to the concept at best, it is not surprising that most planners in the region report that the bulk of future residential development will be low density and single-family ("the market preference of the Denver region," according to a Westminster planner). Accordingly, overall residential densities will increase only slightly by the year 2000, as discussed in the preceding section.

A second factor working against the effectiveness of the activity center as a planning tool is the increasing dispersal of industrial employment. Recent history suggests that isolated sites have a significant appeal to those making site-selection decisions for major industrial facilities. Examples of industrial location decisions fitting this pattern include Storage Technology Corporation (Louisville), Western Electric (Westminster), Michelin (Littleton) and Johns-Manville (Jefferson County). The Johns-Manville location has received considerable publicity, and is an excellent demonstration of the role of corporate image in location decisions. The firm's former chief executive officer - the man who selected the Ken Caryl Ranch as the site for the J-M facility - described his decision in these terms: "A company's headquarters is its signature. I wanted a new signature for J-M" (Reference 999). Image, provision for expansion space, and desirable local characteristics such as lower taxes, lower land prices and more lenient development controls may all play a role in the selection of isolated sites by major employers. These factors may reduce the incentive for firms to locate in activity centers.

A third factor which may be weakening the activity center planning strategy is the decision not to fund mass transit by the Urban

Mass Transit Administration. Mass transit is not a precondition to the success of an activity center's policy; however, the coordination of land use planning policy with mass transit might have resulted in local zoning and planning patterns more strongly reinforcing existing activity centers along the proposed mass transit corridor. With hopes for rail mass transit dashed, there is a loss of incentive to encourage high density uses - residential and commercial - in the travel corridor (which would have linked together a number of the designated activity centers).

A fourth factor which favors the dispersal of economic activity throughout the region is competition among communities for property tax revenues. Fiscal rivalry weakens the regional perspective in land use decisions. The Denver Chamber of Commerce objected to Michelin's decision to locate along the southern edge of Littleton rather than at a site closer to the residential areas where most Michelin workers will probably live (Payne, personal communication). Of course, the cities of the Denver region cannot be faulted for pursuing their fiscal self-interest in trying to attract industry to locations within their perimeters, but local dependence on property tax revenues represents a significant institutional impediment to the implementation of regional land use policies based on nonfiscal environmental and social welfare-criteria.

Population Growth--

As discussed in Section II, a policy population forecast for the Denver region has been adopted by DRCOG which is expected to serve as the basis for the planning of regional facilities throughout the five-county metropolitan area. DRCOG has allocated a year 2000 population of 2.35 million persons to geographic units called urban service areas, which generally correspond to local government planning areas. These service areas are shown in Figure IV-B, and the population allocations are given in Table IV-H.

Local agency forecasts were one source of information to DRCOG's allocation process. These forecasts vary widely in methods and assumptions. A number of the local agencies expressed the view that DRCOG ignored their work and questioned DRCOG's allocation approach, which allocates shares of regional growth to counties. Local planners feel this approach has often disregarded the demand for development in their jurisdictions and their capability of providing services and facilities supportive of new development. DRCOG's communications with local agencies have stressed that local area forecasts must take into account uncertainties with regard to the future availability of wastewater treatment and how these services would be financed.

Disparities between regional and local forecasts are of considerable concern to local governments because local agency applications for federal funds are subject to DRCOG review. The regional council could, at least in theory, determine the size of the grant or whether a given project would be funded. Local agencies believe that, if they attempt to obtain federal funds for wastewater treatment facilities sized to serve a planning period population in excess of that indicated in DRCOG's allocation, they may be denied funds or the amount of their grant might be reduced. Thus, a difference in future population estimates is of importance both to local agencies and to DRCOG. In order to resolve differences, a Cooperative Forecasting Program Task Force was established which included members of local jurisdictions and regional agencies. This group developed a methodology and set of procedures for use in the preparation of local population forecasts, which would be applied both by DRCOG and the local agencies. This work was completed in March 1977, and was used in developing 1977 population allocations.

The projected high growth areas are the urban areas in Arapahoe and Jefferson counties, and the cities of Arvada, Aurora, Boulder Broomfield, Lakewood, Littleton, Longmont, Northglenn, Thornton, and Westminster. Those expected high growth areas which have local agency population projections greater than the 15 percent margin included in DRCOG policies are the urban areas or Arapahoe and Jefferson Counties, Aurora, Boulder, Broomfield, Littleton and Longmont.

The population projections for the high growth areas prepared by local agencies forecast populations of 884,800 in 1980 and 1,448,500 in the year 2000. The DRCOG adopted 1977 allocations for the same years are 831,300 and 1,256,200, respectively. Thus, local agency projections for high growth areas are five percent higher than the DRCOG allocations for 1980, and fifteen percent higher for the year 2000. The 1975 to 1980 growth rate, based on local agency projections would be 5.4 percent per year compared to a 5.1 percent growth rate implicit in the DRCOG allocations. The differences are significant in that about 69 percent of the region's growth is expected to occur in the high growth areas.

Several of the proposed wastewater treatment projects fall within areas whose future populations are in dispute. The Broomfield/Westminster area, for example, differs with DRCOG on what the future population of the subregion will be: the local forecast for the year 2000 for the two-city area if 140,900 (Broomfield, 59,300; Westminster, 81,600) while DRCOG's allocation is 129,900. The local forecast exceeds DRCOG's by about 8.5 percent. The difference for Aurora, which constitutes the majority of the Sand Creek 201 facility planning area is 19.2 percent. As the sanitary district boundaries do not correspond with the boundaries of urban service areas, the extent of disagreement between the local projections and the regional forecasts for the areas to be served by new wastewater facilities is difficult to determine.

Impact of Wastewater Facilities on Land Use--

Major investment in public facilities frequently serves to encourage growth, primarily by opening up land for development. The growth-shaping effects of sewers have been noted in a number of studies (References 983a and 1002), although most case study work has focused on interceptors rather than on wastewater treatment facilities. Such facilities influence an area's growth potential wherever new development is required to be sewered, which is the case in most areas of the Denver Metropolitan Area.

The lack of wastewater treatment capacity in any one area may limit growth for that area, but viewed from a regional perspective, lack of service capacity in one area often diverts growth elsewhere. Growth will go where facilities are available to serve it, as a local building industry representative states (Wyckoff, personal communication, 28 December 1976).

Growth projections for the 201 facility planning areas are given in Table IV-I. Nearly half of the projected growth will occur in the Englewood and Littleton, Sand Creek, and Cherry Creek and Goldsmith Gulch planning areas. See Map J. The most rapid short-term growth rates will occur in the Westminster and Broomfield, Englewood and Littleton, and Sand Creek areas. Generally, all of the planning areas except for South Lakewood and South Adams County will each have a significant share of future regional growth.

Viewing investments in public facilities as having a greater influence on the spatial distribution of growth than on the amount of growth suggests that decisions on whether or not to provide urban services should be viewed in terms of the chain of events they set in motion beyond the service area. Thus, a decision not to serve one area with expanded treatment capacity should take into consideration pressures on the treatment capacity and sewage systems in other areas.

CONVERSION OF AGRICULTURAL LANDS

The "conversion of agricultural land" is the name given to the process which results in a change in the use of land from agricultural to urban. This process may be direct and immediate: autumn's cornfield may be spring's subdivision; or it may be lengthy: orchards may be replaced gradually by row crops and row crops by idle land, over a period of years before construction for urban uses begins. In the meantime, the land may have passed through several successive

Table IV-I. POPULATION GROWTH FORECASTS FOR FACILITY PLANNING AREAS

Facility Planning Area	Population, Thousands[a] 1975	1985	2000	Growth Rate 1975-1985	% of Total Regional Growth to 2000
South Adams County	27	36	50	2.9%	2.6%
Englewood and Littleton	121	199	317	5.1%	22.4%
South Lakewood	100	111	121	1.0%	2.4%
Cherry Creek and Goldsmith Gulch	66[b]	78[b]	90[b]	1.7%	2.3%
Lower South Platte	77	116	132	4.2%	6.3%
Clear Creek	198	246	305	2.2%	12.2%
Sand Creek	82	120	170	3.9%	10.0%
Westminster and Broomfield	24[b]	69[b]	111[b]	11.1%	9.9%
Northglenn	30	43	48	3.7%	2.1%
Planning Areas Total[c]	725	1,018	1,344	3.5%	71.0%

a. Based on facility plan projections except as noted, rounded to nearest thousand.

b. Based on DRCOG projections, facility plans based on DRCOG projections not complete.

c. MDSSD No. 1 includes Cherry Creek/Goldsmith Gulch, Clear and Sand Creek, and flows from Denver Northside plant and its inclusion would largely duplicate enumerated projects.

owners, from the active farm owner to a farm leasor to an owner/real estate speculator to a developer. Whatever the length of time involved and the route taken, the outcome generally is the same: once farm land is converted to urban use, its recoversion to agricultural use is, under normal circumstances, impractical. This section discusses why conversion of agricultural land takes place and why this form of land use change is of environmental concern. It then addresses this issue in the Denver context and discusses historical and potential future conversion of agricultural land.

Causes of Agricultural Land Conversion

Farming is an economic activity. It supplies food and fiber products traded in local, national and international markets, and it provides a livelihood to farmers and farm workers. Obvious to those in the business of agriculture, this point must be made plain if it is to be understood why land is taken out of agricultural use and what kinds of planning and institutional reforms would be needed to affect this process.

The farmer's principal raw material is land. Finding farm land at an acceptable cost is essential if a farmer is to stay in business. "Acceptable" is meant to be a cost at which the farmer makes a sufficient return to prevent him from diverting his assets to some other kind of investment. The farmer faces out-of-pocket costs for labor, fertilizers, pesticides, energy and taxes; he faces fixed costs relating to structure and equipment, as well as to land. A prolonged period of negative net return will put the farmer out of business.

The value of the land is an important determinant of the feasibility of agricultural activity. In the first place, the purchase of land for agricultural use will take place only if the purchaser finds the price low enough to permit him to make a profit; land will be retained in farm ownership as long as its price does not exceed a level at which the return on investment in land falls below what capital invested elsewhere could earn. In the second place, land value (a fixed cost) affects property tax payments (an annual out-of-pocket cost). Rising costs of land therefore increase the costs of operating a farm as well as the costs of owning it. This can be a serious problem at the fringes of urbanized areas, where the value that accrues to land which satisfies the locational requirements of intensive urban uses is usually considerably higher than the income the land can generate in agricultural production. Land which would bring $1,250 per hectare ($500 per acre) for farming use may command $5,000 per hectare ($2,000 per acre) for urban uses. While the farmer cannot influence the changes in the price of his land which arise from its value to others for nonagricultural uses, there are steps he can take to try to keep its agricultural value at or near its nonagricultural value. He can grow higher value crops and/or farm more intensively; in either case, the strategy would be to increase his net return, thereby maintaining a constant capital/output ratio. He can also simply hang on hoping that agricultural product prices will rise and compensate for rising land values. A further mitigating factor for farmers can be the increased land values of their farms. These increased values enable some farmers to borrow money against their increased equities, which allows continued operation. If these approaches are impractical, he (or eventually his heirs) will sell the land, either in small parcels over a period of time or as a block. This is particularly true if the farmer is advancing in years, because the opportunity to sell off small parcels for urban development may provide income for retirement. This is one of the reasons why farmers may object to restrictions on farm land conversions, as is reported to be the case in eastern Adams and Arapahoe counties (Paul, personal communication).

The following discussion of the effects of the current drought on agricultural land conversions is not a prediction of what will be happening in the near future in the Denver region. Rather, it is a discussion which reflects on some of the plausible consequences to agricultural and urban land use patterns should the drought continue beyond this precipitation year. It is by no means comprehensive of all the possible socio-economic effects of which the drought might be a factor.

The current drought could accelerate existing trends to discontinue agricultural activities as greater areas of farmland become marginal due to a lack of adequate precipitation. Drought conditions intensify competition for available supplies of water. The farmer, faced with reduced precipitation, compensates by increased irrigation or by growing crops requiring less water. The latter course is limited because high value crops generally require greater amounts of water. Also, the prices farmers have been getting the last few years have often not covered production costs. Thus, lower value crops are even less attractive. Drought conditions also affect municipal and industrial water supplies. With these competing demands, the farmer most often loses even if he or the canal company hold senior water rights. This is because municipalities can institute condemnation proceedings to convert agricultural water rights to municipal uses. The cities of Westminster and Thornton are now involved in such proceedings.

The farmer has limited flexibility in the amount of water he requires given climatological conditions and the crops he must grow to receive an adequate return. Consequently, urban growth and drought conditions, coupled with low or nonexistent returns from farming have placed the agricultural sector under severe pressure. Because few farmers can afford to retain their lands in fallow for very long, many of them could be forced by financial considerations to sell out.

In a situation such as this, in which neighboring farmers are not likely to be in a position to acquire more land, a "buyers market" can develop for corporate agriculture interests and land speculators. Whenever there is potential for a change in the type of land tenancy, in which lands could change from family farms to corporate farms and speculative land developments, there is also potential for a change in the agricultural economy of the region.

The agricultural capabilities of lands purchased by agricultural corporations would not likely be changed. However, the family farm sector of the region's agricultural economy would be further reduced by some degree. This is a great concern to many of Colorado's family farmers (Reference 977).

In contrast, the agricultural capabilities of farmlands purchased by land speculators are quite likely to be affected. Land speculators operate under financial pressures resulting from substantial interest payments on mortgage notes and from a lack of production income and investment dividends. A common strategy used by speculators to realize returns on rural lands is to minimize the time the land is held. Under this strategy the speculator subdivides the property into the maximum number of parcels local land use regulations and his financial resources will allow. He then makes whatever minimum improvements are required and sells the parcels as small farms, "ranchettes" or large lots. The effect of these smaller parcels is to diminish or eliminate the capability to continue the large scale agricultural operations that were possible prior to subdivision. Although many smaller scale agricultural activities are not precluded and some are actually made feasible by the smaller parcel sizes, it is impossible to predict the utilization plans of a diverse group of new land owners. While some new owners may invest capital and labor into intense agricultural activities, such as truck farming, others may desire only to raise a portion of their own food and keep a few animals. It is all too common, however, for a new owner to also be a speculator who will not use the land productively, but will attempt to divide it further.

This type of speculative activity generally occurs just outside the urbanizing fringe, where local jurisdictions are unwilling to grant entitlements for dense, urban development. Despite such efforts to control "leap-frog" development, the newly diminished, large-scale agricultural capabilities and fragmented, small parcel ownership patterns near the existing urban fringe establish many of the requisite conditions for leap-frogging. Once dense development is introduced into such an area, thereby establishing a precedent for further development, the urbanizing fringe is extended further into the region's agricultural hinterlands. This process occurs with or without drought conditions, of course. As stated at the beginning of this discussion, the factor contributed by the drought is a stimulation of the rate at which the process operates, so that farmlands are converted before the urban region has a well-defined need for them.

To conclude, there is land value maximum beyond which it becomes uneconomical to farm. After this point is reached, the land may still remain in production for a time as ownership changes from the farmer to a corporate agricultural interest or landowner who leases it back to the farmer. It should also be noted that farmers are not always motivated by economic reasons when deciding what to do with their lands. They continue farming because they enjoy living and working on the land, even though they may suffer financially. However, when the point has been passed at which continuation of agricultural use can be assured, it becomes increasingly certain that the land will be urbanized. Farm ownership patterns are a good index of how far the process has gone. In California coastal counties which are still responsible for much of that state's agricultural production, the number of farm owner-operators has fallen sharply since the 1950's. In San Mateo County, a major center for production of brussels sprouts and other vegetable crops, over three-fourths of the agricultural land remaining in 1970 was already operated under leashold arrangements (Reference 989). Conversion to urban uses under such circumstances becomes a matter only of time.

Agricultural Land Conversion as an Environmental Issue

The competition between agricultural and urban uses is often intense because both uses can frequently be provided most efficiently on the same type of land. Urban uses and most crops can be produced most economically on land with slight to moderate slopes, good drainage, relatively little waste area and good water availability. Concern about loss of agricultural land may arise from a socio-economic perspective or from an ecological perspective, or from both.

Socio-Economic Impacts of Agricultural Land Conversion--

As the present century has progressed, the United States has become increasingly important in the international economy as a food (especially grain) exporter. Maintenance of food production both for domestic use and for export is a major concern of some observers, who fear that continued conversion of agricultural lands may ultimately cause a domestic food shortage, resulting in an international shortage: "There has been an overwhelming excess of potentially arable land for all of history, and now, within 30 years (or about one population-doubling time), there may be a sudden and serious shortage" (Reference 998).

While this concern may have a theoretical validity, there seems to be no real danger that the overall national supply situation will be adversely affected by agricultural land conversion in the foreseeable future. In the period since World War II, both Canada and the United States have witnessed a considerable increase in urbanized lands, but at the same time North American grain exports increased dramatically, from 21 million metric tons (23 million tons) in 1950 to 51 million metric tons (56 million tons) in 1970 (Reference 983). This has been possible because of significant productivity increases in both farm land and farm labor. Between 1931 and 1965, per land unit wheat yield more than doubled, from 1.2 to 2.4 cubic meters per hectare (13 to 27 bushes per acre); corn production per land unit more than tripled, from 2.1 to 6.6 cubic meters per hectare (23 to 73 bushes per acre) (Reference 990). At the same time, the farm population fell from 30 percent to less than 5 percent of the total population (Reference 998). Given the overall decline in cropland forecasted to take place by the end of the century, the U.S. Department of Agriculture nevertheless finds that the nation's cropland resources can more than supply domestic and export needs (Reference 720).

However, while the future supply may be adequate, the cost may rise. Over most of the past 45 years, the percentage of disposable income that Americans spend on food has declined. This trend has recently been reversed: in 1972, 15¢ of each take-home dollar was spent on food, but in 1974 that figure had risen to 17¢. This change is cause for concern because lower income families may have food costs per-dollar-earned that are double or triple the national average. Rising food costs are, in part, a land use problem: "part of the rise in food costs can be traced to higher input costs, especially land and structural imbalances in farm units found in mixed land use areas" (Reference 992). In the Denver region and in Colorado generally the cost and availability of water are added problems affecting the economic stability of agriculture.

Farmers need farmers for neighbors. Farm practices and operations tend to conflict with urban uses. Expansion of farm size becomes difficult where farming is at the urban fringe, and farm expansion may be necessary to permit the application of new technology to increase productivity. Average farm size nationally increased almost 30 percent between 1959 and 1969 (Reference 996). The evolution of a land use pattern that intersperses actual and potential urban uses with agricultural uses is inefficient and costly both to food producer and consumer. The situation of agriculture is a local land use is therefore a legitimate environmental concern.

Impacts of Agricultural Land Conversion on the Natural Environment--

Preservation of land in agricultural use results in a number of benefits. Generally, the effect on air is positive since any green cover contributes to oxygen supplies. However, if drought and/or economic conditions result in significant areas laying fallow, wind erosion and particulate air quality problems will result. Agriculture may use significant supplies of fresh water, but some ground water recharge takes place. While farm runoff can be a problem, farmers try to minimize soil erosion. Farming also presents a generally attractive landscape, representing a minimal departure from the "natural state" of the environment. Finally, urban land uses which replace farming would typically have more adverse impacts on the natural environment associated with them.

Agricultural land conversion is part of an overall assessment of land use change which is to be addressed in environmental impact statements. Farmlands classified as "prime" or "unique" are subject to specific consideration under current federal and regional policies. The U.S. Council on Environmental Quality has stated that "efforts" should be made to assure that such farmlands are not irreversibly converted to other uses unless other national interests override the importance of preservations, or otherwise outweigh the environmental benefits derived from their protection" (Reference 103). The benefits cited include provision of open space, scenery and wildlife habitat; it is also pointed out that prime lands by their nature produce more food with less erosion and lower fertilizer and energy requirements. Policy of the Denver Regional Council of Governments calls for discouraging new development in these areas (Reference 204).

Conversion of Agricultural Land in the Denver Region

In the period between 1960 and 1970, land devoted to urban uses in the Denver region increased by 12.3 percent while land devoted to agriculture declined by 6.8 percent. In all, about 13,600 hectares (33,600 acres) were lost to agricultural production, while 16,900 hectares (41,700 acres) were added to urbanized areas. Most new urban land come out of the agricultural category, though some came out of vacant and public use categories. The decline in agricultural use affected every county, as Table IV-J shows. How much of this loss was prime agricultural land is not known.

Table IV-J. AGRICULTURAL LAND USE IN THE FIVE-COUNTY REGION: 1960, 1970 (1,000 acres)

County[a]	Year	Total Acres	Developed	Undeveloped Agricultural	Undeveloped Vacant
Adams	1960	243.0	36.9	189.5	16.6
	1970		46.0	177.2	19.8
Arapahoe	1960	126.8	33.2	80.2	13.4
	1970		36.7	74.9	15.2
Boulder	1960	282.9	64.5	139.0	79.4
	1970		72.6	133.9	76.4
Denver[b]	1960	63.4	46.9	7.4	9.1
	1970		174.0	2.0	8.8
Jefferson	1960	498.2	158.6	76.9	262.7
	1970		174.0	71.3	252.9
Total[b]	1960	1214.3	340.1	492.9	381.3
	1970		381.7	459.4	373.2

[a] Excludes eastern Adams and Arapahoe Counties and western Boulder County.

[b] Detail may not be added to total due to rounding.

Source: Reference 205

The forces affecting agricultural activity, which were described in the preceding pages, will continue to influence land development patterns in the Denver region through the end of the century. It is possible to project conversion of agricultural land to urban land based on existing trends and plans as a way of estimating the magnitude of change which can reasonably be expected if a year 2000 population of 2.35 million is attained.

Three approaches were used in making this projection. The first was to extrapolate existing trends. The second was to calculate the loss in agricultural acreage associated with each added unit of population in the 1960-1970 period and to assume that the same association will pertain through the year 2000. The third was to measure from maps of future land use the acreage of land converted. Only the Denver urban region was considered; eastern Adams and Arapahoe and western Boulder Counties were excluded, as these areas are not expected to experience urbanization.

At this point in the discussion, certain definitions and distinctions must be made clear. There are three terms frequently used in analyzing the effects of urbanization on agriculture. They are "agricultural land", "prime agricultural soils" and "prime farmland". Agricultural land is a term most frequently used by land use planners and generally refers to any land being used for agricultural purposes. This could be anything from hilly range land to irrigated truck farms. Prime agricultural soils are land areas which have all the necessary physical, chemical and topographic characteristics, except sufficient moisture, to support high-quality agricultural production. Within the context of the arid Denver region prime farmlands are areas of prime agricultural soils under irrigation. The distinction between prime agricultural soils and prime farmland is made in this EIS because of the need to identify potential as well as existing highly productive agricultural resources. Land is an in-place resource whereas the water required to fully use the land resource is relatively transportable.

As Table IV-K indicates, agricultural land in the year 2000 would be between 131,500 and 145,300 acres (325,000 and 359,000 acres), depending on the trend line being considered. In the first case, a reduction of 29 percent (54,200 hectares [134,100 acres]) in agricultural land is projected; in the second case, a reduction of 22 percent (40,800 hectares [100,800 acres]) is projected. Note that the coefficient of conversion (area converted per person added to the population) rises the more urbanized the area. This is because in densely settled areas, such as Denver County, land development tends to have a larger complement of nonresidential uses, while in sparsely settled areas, such as Jefferson County, new development is primarily residential.

The projections of agricultural land presented in Table IV-K are trend projections based on the conversion experience of the decade between 1960 and 1970. As is the case with any projection based on past trends, there is an implicit assumption that the conditions which applied in the historic period (1960-1970 in this case) would also apply in the future. This assumption may not be valid. The supply of agricultural land in 1970 differs in location and type from the 1960 supply, and the spatial distribution of urban growth between 1970 and 2000 is not expected to duplicate the 1960 to 1970 pattern. Thus, the projected totals may be reasonable, but the distribution by county may be somewhat different. DRCOG, as shown in Table IV-F, indicates that the total land in agricultural, undevelopable and other vacant categories would be about 136,000 hectares (336,000 acres) in 2000. As this grouping includes additional land use categories, the total may be considered an upper limit. Thus, the 131,000 hectares (325,000 acres) projection for

Table IV-K. PROJECTED YEAR 2000 AGRICULTURAL LAND IN FIVE-COUNTY REGION[a] (1,000 acres)

	Adams	Arapahoe	Boulder	Denver	Jefferson	Total
Year 1970[b]	177.2	74.9	133.9	2.0	71.3	459.4
Year 2000 based on extrapolation of 1960 to 1970 trend[d]	135.0	57.0	114.1	none	53.6	358.6
Year 2000 based on per capita agricultural land conversion from 1960 to 1970[d]	129.5	46.0	106.8	none	43.0	325.3
Coefficient of conversion	0.1885[e]	0.0906[e]	0.0947	0.5208	0.0552	0.1168

[a] Excludes eastern Adams and Arapahoe and western Boulder Counties.

[b] From Table IV-J.

[c] County projections have been proportionally adjusted to sum to totals.

[d] One study (Reference 19) reporting on Adams and Arapahoe Counties found a coefficient of conversion for cropland of 0.148 for the two-county area. Figures for this table cover land in all agricultural uses, not just cropland.

[e] Acres converted per additional person

Source: Table IV-J and References 205 and 262.

case 2 in Table IV-K appears more reasonable. The conversion of 54,200 hectares (134,000 acres) represents a 29 percent reduction in agricultural land.

A comparison of future land use patterns with the distribution of prime agricultural soils reveals the extent of possible loss of existing and potentially productive prime agricultural land to urban expansion. This comparison assumes that the prime agricultural soils, as shown on Map D, are a limited irreplaceable resource and the future land use patterns as defined by DRCOG and shown on Map I will in fact materialize. The results of the comparison are shown in Table IV-L. It is estimated that no more than 2,000 hectares (5,000 acres) of prime agricultural soils would be lost in Jefferson County for a total loss in the region of about 15,400 hectares (38,000 acres). This represents about 23 percent of the prime agricultural soils in the region.

The DRCOG used a similar approach to forecast the loss of prime farmland (Reference 265). Prime farmland, areas of prime agricultural soils under irrigation, was identified and mapped, and then compared to projections of future urban service areas (Figure IV-B) rather than future land use as described above. A total of 35,600 hectares (88,000 acres) of prime farmland was identified of which about 4,000 hectares (10,000 acres) would potentially be lost to urbanization

Table IV-L. ANTICIPATED CONVERSION OF PRIME AGRICULTURAL LAND AS A CONSEQUENCE OF URBAN EXPANSION TO YEAR 2000

County	Number of acres expected to be urbanized
Adams	20,000
Arapahoe	8,000
Boulder	5,000
Denver	Insufficient data
Douglas	400
Jefferson	No published data (estimated 5,000)
Weld	No published data

These sharp declines in agricultural land use in the five-county area represent only part of the likely future state of agricultural activity in the region. As the agricultural lands on the fringe of the Denver urbanized area are gradually converted to urban use, there will be increased pressure to expand and intensify agricultural activity in areas just beyond the metropolitan region. These pressures would be felt most strongly in eastern Adams and Arapahoe Counties, southern Weld County and northern Douglas County. If supplies of water for agricultural use permitted, increase agricultural production in those areas would take place, with little loss in overall production despite urbanization of some cropland. However, water is a far more important constraint on agricultural activity than is land in this region. Local agricultural experts report that urbanization threatens continued agricultural activity less because it absorbs agricultural land than because domestic water users have priority over agricultural users in the allocation of water. The condemnation of water rights may make farming economically infeasible long before pressures for conversion of agricultural land are experienced.

AIR QUALITY IMPACTS

Introduction

For several years, it has been presumed that acceptable air quality in Denver was one of the main limiting factors for future growth in Denver. The "carrying capacity" of the Denver airshed appears already to be exceeded, given current frequent violations of air quality standards. It was anticipated that planned growth, which required the support of wastewater treatment facilities, would add to the problem and lead to unacceptable air quality in Denver from the present to the year 2000. This was expected to be true in spite of adoption of a Denver Transportation Control Plan, under which specified measures might be taken to improve air quality. For this reason, a detailed analysis of air quality was performed for this EIS to investigate the probable future impacts of the proposed wastewater projects and the Clean Water Plan. This analysis was performed by Systems Applications Incorporated under contract to EPA. A report of this work is available upon request and is listed in the Bibliography as Reference 998.

A major goal of the Denver study was to predict the effect of land use and population forecasts used in planning the eight proposed wastewater treatment facility plans (201) and the Clean Water Plan (208) on future Denver (1985 and 2000) air quality. In order to assess the relative impacts of such actions, air quality was modeled for future years for various pollutants to attempt to estimate the air quality consequences of future growth.

Since urban growth and development and the attendant changes in pollutant emissions depend on factors in addition to the availability of sewage systems, and in particular, since urban development depends on decisions not yet made, predictions of the air quality effects of future growth are not simulations of complete certainty. The analysis of Denver's future air quality has become an exercise in hypothesis. The question is not so much "What will Denver's air quality be?", but rather, "What will Denver's air quality be if...?". There is no single unique analysis of future air quality. The variation of air quality with changes in assumptions is an important aspect of the analysis, but to define these changes, there must be an initial condition from which to measure departure.

The initial or base condition of Denver's air quality for the future years under study, 1985 and 2000, is taken to be the state which would most probably be realized. This condition assumes automobile emissions which do not strictly meet federally mandated levels and future growth as projected by DRCOG. Since plans and projections for Denver's future have been formulated, examined and accepted in the absence of this air quality analysis, those plans become the "base" for assessing probable future air quality impacts. Variations from this base case for future years are evaluated to some degree in this EIS. Evaluations of other strategies for controlling air pollution are and will continue to be done by state and regional agencies.

Modeling Air Quality in Denver

The Denver Air Quality Model (DAQM, Reference 998) was utilized to predict ozone concentration. Modeling of photochemical oxidants is exceedingly complex. The major oxidant of concern, ozone, is not generally emitted from man-controlled sources. Significant background concentrations of ozone from natural sources can and do occur. It is generally believed, however, that critical ozone concentrations in urban airsheds are produced by chemical reactions in the atmosphere between atmospheric oxygen, nitrogen oxides, gaseous hydrocarbons, and other less significant compounds. The primary sources of nitrogen oxides and hydrocarbons in the urban atmosphere are combustion machines, most importantly, motor vehicle engines.

The primary nitrogen oxide species emitted is nitric oxide (NO). In the presence of large amounts of NO (relative to NO_2 quantities), it typically takes from one to several hours for the NO_2/NO ratio to become high enough for significant ozone to form. In such a time period, precursor materials are likely to blow far from their sources and become significantly dispersed. For this reason, ozone concentrations are likely to be quite sensitive to wind patterns and atmospheric mixing. Concentrations of nonreactive pollutants such as CO and particulates are often more clearly related to wind speed, direction and stability near their source, than to regional wind patterns, since they become quite diluted for long dispersion times.

Models which do not take account of wind patterns are not expected to predict ozone patterns well; therefore, in this study, a grid based physio-chemical model was used for the analysis of regional photochemical oxidant.

Particulates and NO_2 were analyzed with the Gaussian Climatological Dispersion Model (CDM); however, it is very important to note that most NO_2 in an urban atmosphere is not emitted, but is a product of photochemical reactions just as is ozone. Thus, CDM, which does not include chemistry algorithms, assumes all emitted NO to be equivalent to NO_2. This is probably valid for far downwind locations, but is clearly not even approximately true at the times and places for which maximum NO_2 concentrations are computed with CDM. Therefore, the reactive model DAQM was also run to predict hourly NO_2 concentrations for the years 1974, 1985 and 2000. Annual average NO_2 concentrations were then inferred from the DAQM results. See Reference 998.

Carbon Monoxide (CO) is inert and does not react in the atmosphere. As a result, carbon monoxide concentrations are generally highest near the source (e.g., from automobiles, the highest concentrations occur along the roadway and intersections). A grid model does not estimate "local hot spot" areas, but rather calculates averages within the area of the grid. However, for a regional scale analysis, the DAQM grid model was utilized to evaluate future CO levels.

Information on further localized "hot spot" CO concentrations was taken from the I-470 Air Quality Impact Study performed by the Colorado Division of Highways (CDH). In these calculations, CDH used the California Line Source Model to evaluate the microscale CO effects.

Error Discovered

Since issuance of the draft EIS, an error has been discovered in the emissions input to the Denver Air Quality Model. This model was used to predict future ozone, NO_2 and CO concentrations reported in the draft EIS. The effect of the error was the omission of major quantities of NO_x emitted by one large source and minor quantities of all pollutants emitted by several smaller sources. Carbon monoxide and hydrocarbon emissions and results were not significantly affected by this error.

The nature of the error was that the list of point source emissions, mainly from industrial smoke stacks, was only partially added to the total inventory of emissions. Truncation of the list varied from hour to hour and run to run, but some or all of the emissions from the Cherokee power plant were omitted at all times. This one source emits about 40 percent of the entire regional of NO_x. All vehicular, area source, small point source and aircraft emissions were added correctly. Therefore, the error places in question less than 42 percent of NO_x, less than 3 percent of hydrocarbons and less than 5 percent of CO emissions.

To determine the effect of this error, "base case" simulations were rerun for 29 July 1975 and 3 August 1976 with corrected emissions inventories. In addition, a year 2000 simulation was repeated for 28 July meteorology to determine the effect of the power plant emissions for a future case where other regional emissions were much reduced.

The results of these simulations showed noticeable differences in ozone concentration in the path of the Cherokee power plant plume, but no conclusions of the draft EIS were invalidated. This was because validation comparisons between existing data and predictions were made at observing station locations which were not often directly impacted by the power plant plume. The peak ozone concentration for 29 July 1975 was computed to be one part per hundred million (pphm) less than previously reported (22 pphm versus 23 pphm). The peak was computed as occurring at the same time (1200 to 1300 hours) and at the same place (just west of Green Mountain). Simulations for 3 August 1976 also yield the same peak ozone time and location as before, and the new peak concentration is 22 pphm rather than 24 pphm. Areas of exceedances showed differences, but they do not appear significant. In fact, the maximum area of exceedance of the ozone standard remained virtually unchanged from that of the previous results (780 to 1,040 square kilometres [300 to 400 square miles]).

For the year 2000 predictions, peak computed ozone concentration, location and time of day were unchanged by inclusion of the power plant emissions. Computed areas of exceedance of the ozone standard for the year 2000 are very small in either case.

Because there were no significant changes in the results reported in the draft EIS due to this error in emissions input, the values reported in the draft EIS have not been changed in this final EIS. The minor differences in ozone concentrations which were found to be attributable to this error do not change the conclusions which were reported in the draft EIS or the reference report, and the following discussions are considered still valid.

Data and Assumptions

For the purposes of evaluating and modeling present and future air quality in the Denver Metropolitan Area, a number of emission files of estimated present and future emissions of various air pollutants were provided by the Air Pollution Control Division of the Colorado Department of Health and by the California Division of Highways.

In general, highway and nonhighway traffic account for a major fraction of most of the pollutants emitted. While automobiles and other vehicles do not directly contribute to the particulate problem, a large percentage of the particulate matter results from materials on streets thrown up by vehicles (45 to 60 percent of the total particulate emissions). Point sources contribute the next largest percentage of emissions and these sources account for as much as 50 percent of the total NO_x emissions as well.

The emissions which were utilized in the DAQM validation for the days in 1975 and 1976, consisted of reactive hydrocarbon and nitrogen oxide emissions to determine photochemical oxidant concentrations. To determine CO concentrations, estimates of these emissions were also input into the DAQM model.

Future emissions were estimated with emission factors based on recent a to emission test results. These emission estimates are higher than the current and optimistic EPA vehicle emission factors from AP-42 Supplement #5 for 1985 and 2000. This approach was used because recent auto emission tests demonstrate an inability to achieve the required emission reductions in new cars and the inadequacy of emission control system maintenance.

Point sources were projected to the years 1985 to 2000 by assuming that increases in emissions were directly proportional to the increase in area of industrially-zoned land. Future zoning changes were determined from various land use plans and population projection forecasts. Space heating and other area-wide emissions were computed based on population forecasts and projected land use allocations.

The emissions that were used in predicting 1985 air quality are presented in Table IV-M. Emissions were estimated in the summer and winter months and revealed the following:

- Winter emissions exceeded summer emissions for three pollutants (reactive hydrocarbons, nitric oxides and carbon monoxides). This was due to an increase in auto emissions in the winter. The most significant differences were obtained from carbon monoxide emissions.

- Automotive emissions of carbon monoxide, hydrocarbons and NO_x are higher than Supplement 5 estimates because of the lack of proper maintenance of emission control systems, the failure of emission controls equipment, and the apparent inability to achieve the required reduction of certain pollutants for new cars.

- Point sources contribute almost 15 percent of the reactive hydrocarbon emissions and about 10 percent of the carbon monoxide emissions.

Table IV-M. DENVER EMISSIONS INVENTORY (Tons Per Day) FOR 1985 AIR QUALITY PROJECTIONS

Season	Reactive HC	NO_x	CO	Particulates
Winter	171	304	2273	130
Summer	138	269	1508	130
TOTAL	309	573	3781	260

Source: Systems Applications, Inc.

Emissions utilized to project year 2000 air quality levels are presented in Table IV-N. Emissions for this year were calculated on a summer and winter basis for different source categories. An examination of this table reveals the following:

- Winter emissions exceed summer emissions for three pollutants (hydrocarbons, nitrogen oxides, and carbon monoxide).
- Emissions of carbon monoxide and hydrocarbons decrease from 1985 but nitrogen oxides are predicted to increase over 1985 levels.

Table IV-N. DENVER EMISSIONS INVENTORY (Tons Per Day) FOR 2000 AIR QUALITY PROJECTIONS

Season	Reactive HC	NO_x	CO	Particulates
Winter	117	330	1220	158
Summer	105	277	1093	158
TOTAL	222	607	2313	316

Source: Systems Applications, Inc.

Model Validation

Ozone Validation --

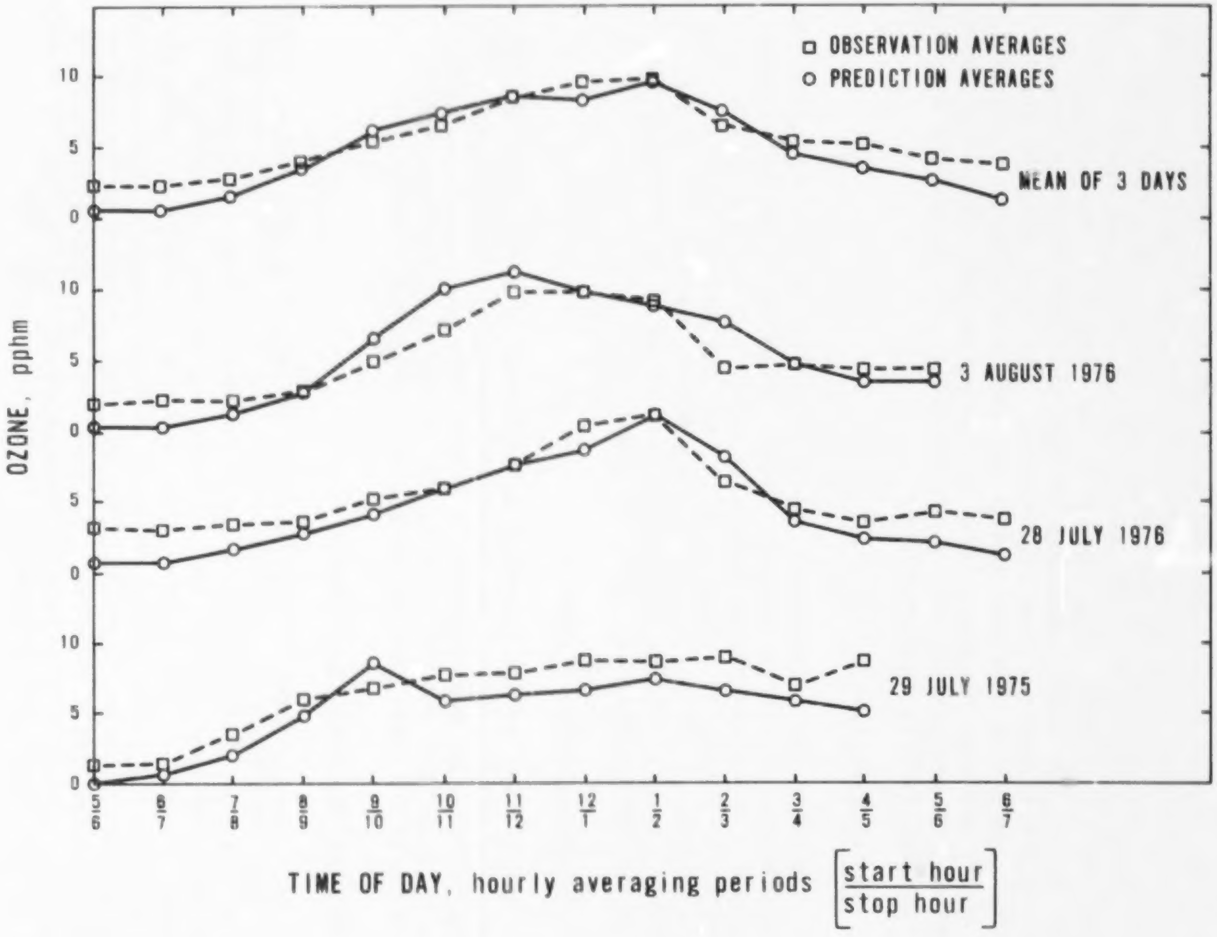
The Denver Air Quality Model (DAQM) was validated for ozone on summer days, 29 July 1975, 28 July 1976 and 3 August 1976; since these were the only days for which meteorological data were available and for which sufficient air quality data were available with which to compare the simulation results. The 1975 day did not approximate a worst day for 1975, but significant violation (11 pphm) of the ozone standard (8 pphm) was observed. The second (18 pphm) and third (16 pphm) highest ozone observations of 1976 were on the two days of that year simulated. The two 1976 summer days were subsequently used with future emissions to predict 1985 and 2000 air quality.

The simulation for 28 July 1976 yielded a peak computed ozone level at any monitoring station of 16 pphm, the same value as was actually measured. However, the peak ozone level computed for that day occurred elsewhere in the region, and was 22 pphm. The simulation for 3 August 1976, computed a station peak level of 15 pphm. The observed value was 17 pphm. Again, the peak computed anywhere in the region was higher than any observed value, namely 24 pphm. Therefore, there is no assurance that current monitoring stations are recording the peak ozone levels occurring in the region, or that they will do so in the future.

Nearly 300 comparisons were made between hourly-average concentrations computed for grid cells, and concentrations observed in the atmosphere at corresponding points. These comparisons are presented and discussed in Reference 998. Although there were substantial differences between computed and observed concentrations on some occasions, on the whole, impressive correspondence between them was noted. The differences were not so large as to distinguish between simulation and observational error.

The plots in Figure IV-C show differences between computations and observations averaged over time at stations, over stations at each hour over both time and place for each simulation day and for all days. The averages were examined for evidence of regularities that would suggest correctable error in the formulation of the model. Computed results did average lower than observations early in the morning and late in the afternoon. Generally, the model predictions compared very well with observations.

FIGURE IV-C



THE VARIATION OF AVERAGES OVER ALL STATIONS OF OBSERVATIONS AND PREDICTIONS

Carbon Monoxide Validation --

The carbon monoxide validation actually did not produce as favorable results as did the DAQM ozone model. At certain monitoring locations for some of the simulated days, good agreement between simulated and observed concentrations was found. In other cases, substantial differences exist between observations and simulated concentrations. In part, this is due to the nature of the computer model used. The model simulates average CO concentrations over a 11.4 square kilometre (four square mile) grid cell, whereas air quality monitoring stations sample air at a single point. Therefore, the model predicts regional scale CO concentrations while monitoring stations are greatly influenced by very local CO emissions from nearby road and traffic intersections.

NO_x Validation --

Available NO_2 information was totally inadequate for validation of the models for these species. Since the Climatological Dispersion Model (CDM) was not used in this study for drawing inferences relative to future NO_x levels, no attempt was made to validate CDM for purposes of NO_2 prediction. The inferences drawn for NO/NO_2 probable impacts and mitigations have not been scientifically validated and merely represent best estimate.

Particulate Validation --

The CDM was used to predict particulate concentrations and was previously calibrated by the Colorado Department of Highways. Background levels and the calibration coefficients previously determined were utilized for the CDM runs in the Denver study and no attempt was made to validate the background or calibration coefficients.

Denver Air Quality Projections

Estimates of present and future air quality in the Denver region were made from model computations using the Denver Air Quality Model (DAQM) and the Climatological Dispersion Model (CDM). Computations were made for comparison with each National Ambient Air Quality Standard (NAAQS). The DAQM, a "real time" model was used to estimate the highest occurring hourly average concentrations of ozone, carbon monoxide and nitrogen dioxide. The DAQM results were used to make inferences regarding potential violations of the annual average NO_2 standard. A much more complete description of the air quality modeling efforts discussed here can be found in Reference 998.

Ozone --

As described previously, two of the three summer days for which data were available were reasonably representative of worst case ozone episodes. Results of future simulations using meteorological data from these days and compared with 1976 simulation results show that peak ozone concentrations are predicted to drop from 24 parts per hundred million (pphm) in 1976 to 15 pphm in 1985 and 11 pphm in 2000. For each of these years, the predicted ozone concentrations exceed the standard of 8 pphm.

Results of the model simulations also showed decreases in the area extent of violation over time. In 1976, the area computed as exceeding the ozone standard covered a maximum of 780 to 1040 square kilometres (300 to 400 square miles) at any one hour. By 1985, the computations show only about 340 to 480 square kilometres (132 to 184 square miles) in violation of the standard. By 2000 the area is reduced to 70 to 100 square kilometres (24 to 40 square miles).

Carbon Monoxide --

Carbon monoxide concentrations were computed with DAQM for a bad (poor dispersion) winter day in November 1974. Winter days in the Denver Metropolitan Area tend to be most crucial for nonreactive pollutants, since the low solar intensity and low wind speeds permit the shallow morning mixing layer to last longer and sunlight is not required for production of the nonreactive pollutants.

The concentrations gradients of nonreactive pollutants can be much larger than for ozone. This is because peaks occur very close to the sources (primarily traffic for CO) before dispersion dilutes the pollutant material. As a result, the definition of peak concentrations of CO is very difficult. CO monitors on opposite sides of a heavily travelled street can easily show concentrations differing by a factor of two or even an order of magnitude. The DAQM computation has a two-mile resolution and, therefore, the microscale street effects would be suppressed.

Under present conditions, CO violations can surely be found in any major urban area at particularly critical spots such as industrial, shopping centers or stadium parking lots or at busy intersections. This is known to be true for Denver. The DAQM predicted on a regional scale, that the average CO concentration over an eight-hour period was 16 parts per million (ppm) for 1985, and 5 ppm for 2000. The eight-hour standard is 9 ppm. Therefore, on a regional scale, CO concentrations will exceed the standard for 1985, but be below the standard by 2000.

1985 and year 2000 analysis utilizing the California Line Source Model were conducted by the Colorado Division of Highways to evaluate the microscale effects for its proposed I-470 alternatives. The analyses of the modeling results indicated that the highest level of CO for the years 1985 and 2000 will be experienced along the Santa Fe Drive. The one-hour CO standard was predicted to be exceeded in the Cinderella City area in 1985 and is exceeded for most traffic concentrations in year 2000. Since the results of these analyses by the Highway Department were based on optimistic emission factors, it is probable that these results are low. Also, calculations in the analyses were made on a one-hour basis and it would be expected that many eight-hour "hot spots" violations would occur in 1985 and 2000, since the eight-hour air quality standard is more often exceeded than the one-hour standard.

Nitrogen Dioxide --

Estimates of long-term nitrogen dioxide (NO_2) concentrations are difficult to determine. The primary emitted species is NO. After entering the atmosphere, NO is typically oxidized to NO_2 in the same complex photochemical reaction that generates ozone. Because NO eventually becomes NO_2, the typical standard violation analysis computes, not NO_2, but NO_x concentrations assuming all NO_x emissions are NO_2. Since an annual average is desired (the standard for NO_2 is annual average), NO_x modeling is usually done with the EPA Climatological Dispersion Model (CDM) or other annual climatological models.

While all NO may eventually oxidize to NO_2, all emitted NO is clearly not NO_2 at all positions along its downwind path. NO_x is particularly not NO_2 while it is still near its source where it is most dense. CDM can therefore be expected to seriously over estimate NO_2 in the dense source areas of a region. CDM estimates should be more accurate near the periphery of the modeling region.

CDM is a calibrated model; that is, its results are multiplied by a factor to make them correlate with observed conditions. The Denver region has had just one NO_2 monitoring station which is the center of the downtown NO_x source area. CDM results were calibrated with data from this station and they should be equivalent to the observation at that site for the calibration year. The results from CDM should be progressively more in error (under-predicting) with distance from the calibration site. Since the emissions of all interacting species change differently years into the future, the calibration should not be valid for future years.

The problem of the complex photochemical reactions for NO_2 formation could be resolved by using DAQM; in fact, NO and NO_2 concentrations are computed by DAQM. Use of this model does not, however, give annual averages and therefore direct comparisons with the NO_2 standard cannot be made. Peak NO_2 hourly average concentrations computed with DAQM for worst case summer days show decreases in NO_2 from 1976 to 1985 and again to 2000. This is in contrast to predictions of steady increases of NO_2 using the erroneous assumptions of CDM. The conclusions that may be drawn are:

- Observations show current compliance with the NAAQS standard of 5 pphm NO_2 on an annual basis; however, the one station recording NO_2 concentrations may not be located in an area of high concentration.

- Annual average NO_2 concentrations may not increase in future years. They may decrease somewhat.

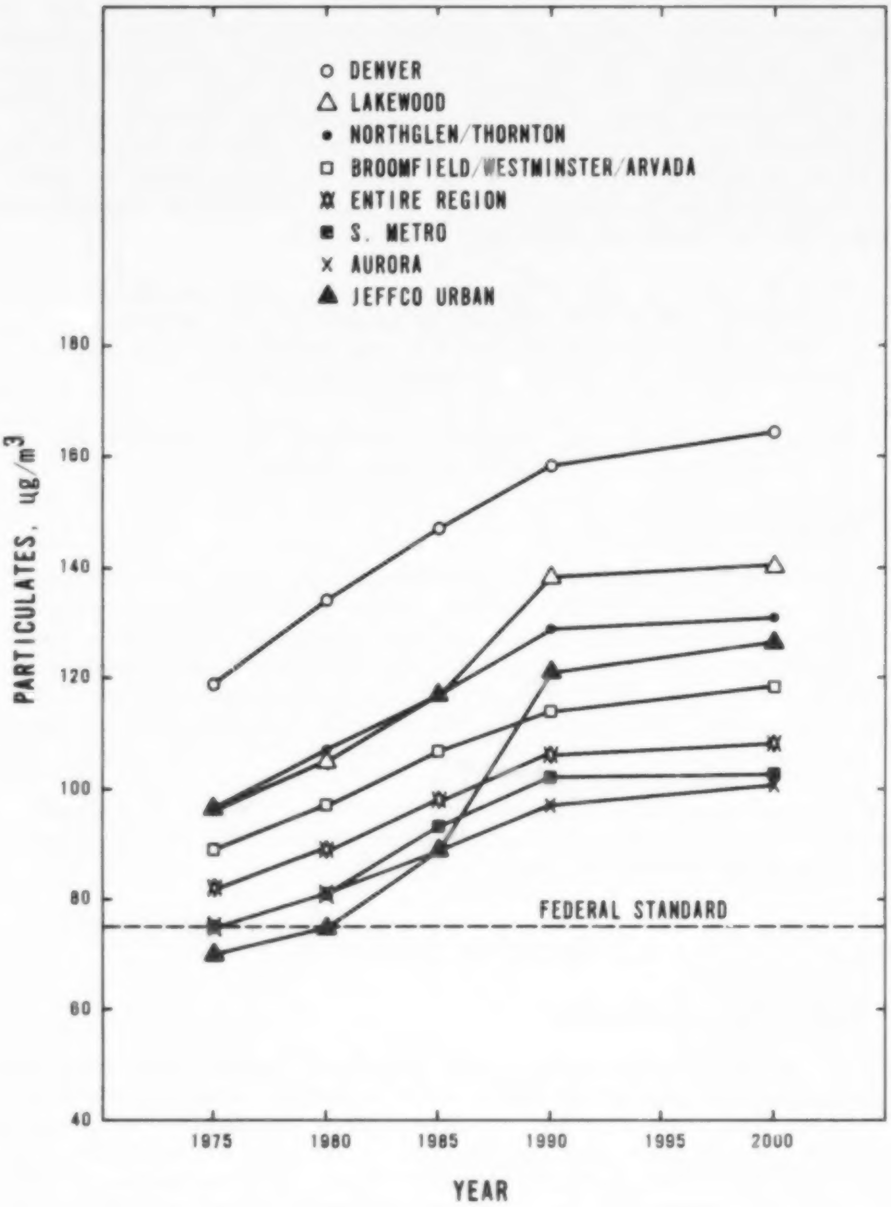
Particulates --

Annual average particulate concentrations were computed with CDM. The model results were calibrated with observational data. The predicted concentrations are so high (four to five times the State standard) that current and future violations are expected. The NAAQS for particulates was predicted to be exceeded over 1190 square kilometres (460 square miles) in 1974, 1420 square kilometres (548 square miles) in 1980, 1780 square kilometres (688 square miles) in 1985, 1850 square kilometres (716 square miles) in 1990 and 1880 square kilometres (724 square miles) in 2000. Figure IV-D shows the average annual particulate concentration projections for various areas around the Denver Metropolitan Area.

A summary of the results of the analysis of future Denver region air quality is presented in Table IV-O.

Uncertainty of Results

Air quality impacts previously discussed assume that emissions for future automobile model years will be higher than required by the Federal Emissions Control Program. This assumption is based on the present experience indicating that a fraction of vehicles experience early catalyst failure, another fraction have engine maladjustments, and the remaining fraction are properly tuned vehicles with operating catalyst. It is also assumed that as a model year becomes older, more vehicles experience catalyst failure and become maladjusted. If these fractions are all taken into account, it results in limited success of the emissions control program. Any significant variance from these assumptions could result in different results as explained in the discussion of the effectiveness of a vehicle inspection and maintenance program.



AVERAGE PROJECTED PARTICULATE CONCENTRATIONS 1974 TO 2000

Table IV-O. DENVER AIR QUALITY PROJECTIONS

Model	Pollutant	Federal standard	State standard	Computed maxima			Area of exceedance (mi^2)		
				1976	1985	2000	1976	1985	2000
DAQM	Ozone	8 pphm 1-hr.		24	15	11	300-400	132-184	24-48
DAQM	CO	35 ppm 1-hr.		26	27	6	*	*	*
	CO	9 ppm 8-hr.					*	*	*
DAQM***	NO_2	82 $\mu g/m^3$ annual average		79	75	74	*	*	*
CDM	Part.	75 $\mu g/m^3$ annual average	45 $\mu g/m^3$ annual average	168	217	229	460	688	724

* Not calculated

** Observed Value

*** Annual averages determined from peak hour values based on proportionality between observed values. See Reference 998.

The vehicle emissions used in this analysis also assume some delay in the required implementation date for emission control limitation. It was assumed that the implementation dates for carbon monoxide and hydrocarbon standards of 3.4 grams per mile and 0.41 grams per mile, respectively, would be delayed one year from 1978 to the year 1979. The required implementation date for the NO_x standard was assumed to be delayed until 1981. The presently required date is 1978. Now the Clean Air Act Amendments have been passed and the standards for the next several years have been established. Unfortunately, the assumptions used in this EIS now appear to be very optimistic with respect to air quality in future years. For the first time, 1977 cars were required to meet emission standards at Denver's altitude as well as at sea level. Congress has since delayed that requirement until 1984 and accordingly, cars sold in Denver are not required to be compensated for altitude until that time. There are, however, provisions for regulatory interim standards for new high altitude vehicles as well as other provisions allowing EPA to require the auto makers to provide high altitude "fixes" for some vehicles now in use. Both provisions would require EPA to go through the standard rule-making regulatory processes and therefore could not be brought into effect for approximately one year.

The recent amendments set emission standards for sea level conditions for carbon monoxide at 15 grams per mile (gpm) until the model year 1979, 7.0 gpm in 1980 and 3.4 gpm, the statutory requirement in 1981. For hydrocarbons, the standard will be 1.5 gpm until 1980 when it changes to the statutory standard of 0.4 gpm. The NO_x standard remains at 2.0 gpm until 1981 and then becomes 1.0 gpm for subsequent years.

The most likely course of events for future emissions appears to be that there will be some sort of interim high altitude standard imposed for new cars, between now and 1984, and quite likely some "fixes" may be applied to cars in use. Nonetheless, the emissions assumptions used in the modeling effort were quite optimistic no matter what interim high altitude restrictions might be imposed prior to 1984.

The modeling of ozone and carbon monoxide utilized meteorological data from two summer days in 1976 and one winter day of 1974, respectively. Therefore, as a result, assumed future meteorological conditions are identical to those that occurred on these days. Although it is assumed these days are representative, and to some degree typical, of higher ozone and CO pollution episodes, meteorological conditions will vary from year to year. For this reason, a sensitivity analysis was performed for ozone to determine the variability of results obtained to changes in the meteorological assumptions.

Lower average wind speed and shallower average mixing layers than were originally estimated from the data were investigated. Specifically, a one-third decrease in wind speed and in mixing layer thickness was assumed separately and together. The decreases were proportionate in every grid point, thus all wind patterns were preserved. Results of these model simulations showed that a one-third decrease in wind speed increased the peak ozone concentration by only 1 pphm but increased the total area subject to standard violations by 210 square kilometres (80 square miles). Nearly the opposite was the case for the one-third lowering of the mixing layer thickness, with peak ozone concentrations increasing by 4 pphm, but the area of violations increasing only by 80 square kilometres (30 square miles). Both meteorological parameters would change peak ozone concentrations by much more than the sum of the individual effects. For one-third decreases in both wind speed and mixing layer thickness, peak ozone concentration increased by 8 pphm and the area of standard violation increased by approximately 260 square kilometres (100 square miles). It appears that the assumed meteorological estimates would have to be in error by a substantial amount in order to invalidate the previous ozone results.

For the meteorological conditions evaluated, it is assumed that there is no carry-over of pollutants from one day to the next, nor any reentry of pollutants during a single day after they have left the modeling area. In Denver, the afternoon mixing layer is typically quite deep, as compared with morning conditions. This, together with the lack of any topographic barrier on the east and north, which are both downhill and downwind in a nighttime drainage flow, make carry-over of pollutants from one day to another unlikely. This conclusion is reinforced by the observation that the peak ozone days occurred singly in the summer monitoring program of 1976.

However, it appears that wind reversals during midday hours can bring the pollutant cloud back to the region after it has left the model boundary. For ozone the situation cannot be treated correctly by the model since the concentrations change by unknown amounts while material is outside the analysis region. Given the rapid thickening of the mixing layer, dilution is likely to be far advanced when reentry of the ozone cloud becomes an issue.

While the possibility exists that days could occur when the characterizations involved are not valid, the situation described is, however, consistent with maximum ozone concentrations observed in Denver.

Since the boundaries of the Denver Air Quality Model are defined by an 80 x 80 kilometre (30 x 30 mile) square, centered over Denver, the potential downwind effects are not modeled. Downwind ozone and NO_2 concentrations may also be a problem under certain conditions.

The annual average particulate results are estimated with the use of a "calibrated" model which factors the model results to more closely resemble the observations. Also, a large fraction of the model results are attributed to "background" particulate concentrations rather than identified emissions. Therefore, particulate results are sensitive not only to the estimated particulate emissions, but also, to the assumed "background" level and calibration constants.

In predicting future NO_2 concentrations in the Denver region, uncertainty exists as to the present level of NO_2 concentration since there is only one NO_2 monitor and it may not be located so as to pick up the peak concentrations. This is important in that the probability of future violations of the NO_2 standard is based in part on present measured concentrations of NO_2. If, in areas of the Denver region, the NO_2 standard is being violated where no monitoring presently exists, the likelihood of future violations of the NO_2 standard would be increased.

Probable Effects of an Automobile Inspection and Maintenance Program

A motor vehicle inspection and maintenance program will not eliminate the pollution problem in the Denver area, but it is a necessary first step in attacking one of its major sources. Last year legislation was passed mandating inspection and maintenance beginning in 1980 for cars of 1977 and later model years. Now, however, because of the recent current swell of public concern of air pollution (see Volume I) the legislation is apparently going to be strengthened. One proposal would begin the program in July of 1978 and would mandate inspection for 1974 and later model year cars. Although the legislation is pending at this time and the outcome is uncertain, it appears that the Inspection and Maintenance Program passed last year will be improved.

It is proposed that the inspection and maintenance program would work in much the same way as Colorado's safety inspection program. It is estimated than as inspection will cost around $5.20. The program will not only reduce air pollution, but will also result in gasoline savings through more efficient engine performance.

The exact impact on air quality of the proposed inspection and maintenance program has not been determined. The air quality impacts discussed in the analysis assume that an inspection and maintenance program is not in effect. Estimates of the air quality in Denver have been made assuming very strict compliance of automobiles with the federally mandated auto emission limitations. In fact, strict compliance is not being achieved today and is not projected to even be approached in the future without some kind of inspection and maintenance program. This is due to the fact that:

1) manufacturers are presently not able to produce cars which meet all of the emission limitations; 2) a certain percentage of cars experience early failure of the catalytic converter (the principal emissions control device) and; 3) many automobiles are not properly maintained to meet the emission limitations and others are maladjusted. An inspection and maintenance program will greatly reduce the latter two problems in meeting the Federal Emission Standards.

Although not exactly the result of implementing an inspection and maintenance program, strict compliance with Federal Emission Standards would reduce carbon monoxide concentrations by almost 40 percent of that projected for 1985. Regionally, although not in all "hot spot" locations, adherence to auto emission standards would bring CO concentrations very close to the eight-hour ambient standard in 1985. For ozone, the effects of properly controlled automobile hydrocarbon emissions would not be as great as for CO. Peak ozone concentrations would be reduced for 15 pphm to 13 pphm in 1985, a 13 percent reduction; and from 11 pphm to 9 pphm in 2000, an 18 percent reduction.

Possible Effects of a Relaxation of the NO Emission Standard

In another assessment of the possible effects of changes in vehicle emissions, an attempt was made to evaluate the impact on ozone and NO_2 concentrations of an increase in NO emissions. This air quality simulation assumed a relaxation of the NO_x emission standard to 1 gram/mile NO_x emissions rather than the previous 1978 goal of 0.4 grams per mile. This simulation was performed before the Clean Air Act Amendments of 1977 were passed, and incorporates only one of several changes mandated by the amendments. Therefore, the results of this simulation are of limited value in evaluating the effect of the Clean Air Act Amendments on Denver's future air quality. However, the simulation does provide an improved understanding of the causes of air quality problems in the Denver region. Results of this simulation for conditions otherwise the same as the 1985 probable impact results showed only slight violations of ambient standards for ozone and no increase in peak NO_2 concentration. In strict compliance with Federal Vehicle Emission Standards, as discussed above, except for the proposed relaxation in the NO_x standard, no violation of the ozone ambient standards was predicted for 1985.

The reason for the apparent improvement in air quality with increased NO emissions is that the ratio of the two ozone precursors, hydrocarbon and NO become unbalanced. Not enough hydrocarbon would be present to oxidize the NO to NO_2 to in turn produce ozone before atmospheric mixing and dilution lowered all concentrations. This result is specific to Denver's bad ozone days (3 August and 28 July 1976). Regions with other emission mixes or patterns and other dispersion climatology can expect different results. Specifically areas with more persistent inversion conditions will probably have a worse ozone and NO_2 problem with the NO emissions standard relaxed.

As was previously discussed, the Clean Air Act Amendments have been passed and the NO emission standard has in fact been set at 1 gpm beginning in 1981. However, the simulation which was conducted for this scenario also assumed much stricter and earlier compliance with the statutory hydrocarbon standard of .41 gpm than will be the case under the Clean Air Act Amendments. Therefore, higher ozone levels than the model predicted could logically be expected in the future. Additional studies by EPA and the State of Colorado will address this point in more detail. Therefore, this simulation does not represent an accurate protrayal of the effects of relaxation of NO_x and hydrocarbon standards which has now taken place.

It should be noted that relaxing the NO_x standard results in a larger NO plume coming from Denver. Any downwind area releasing hydrocarbons into this plume will experience large ozone concentrations because of the reaction with the NO_2 originating from Denver's NO emissions. Also, the predicted decrease in ozone concentrations in the Denver region would, of course, be accompanied by increases in NO concentrations. Although there is no federal air quality standard for NO, (only an NO_2 standard), it is not probable that increased NO concentrations are desirable. NO does oxidize to NO_2 and NO_2 is a regulated pollutant. Increased NO emissions do not necessarily lead to increased NO_2 concentrations in the Denver region for reasons similar to those explaining the ozone reduction. Increased downwind NO_2 concentrations could, however, be expected, because of the longer time available for the conversion of NO to NO_2. It follows from the foregoing that relaxation of the NO standard should not, as a result of this study, be considered an ozone control strategy. Furthermore, potential downwind effects of the standard relaxation on NO and ozone have not been evaluated and neither have potential impacts on public health of higher NO concentrations in Denver.

Effects on Agricultural Crops

The effects of air pollutants have been well documented. However, much is yet to be learned, and methods for forecasting dollar loss as a function of air quality and crop type are not well developed. Reference 908 is the only method which has been applied to obtain national estimates. This method, termed the Factor Method, provides a means for determining loss from a series of factors which account for emissions, meteorology, frequency of episode days, and crop sensitivity. Alfalfa is the only crop for which an alternative method if available. See Reference 909. This method relates dose, in pphm - hours exposure to ozone, to percent reduction in productivity. Using 1974 ozone data from the Welby air quality monitoring station, dollar losses for alfalfa ranged from 16 to 24 percent.

Using the Factor Method, a loss of 20 percent for alfalfa is forecast. When the Factor Method is applied to the crops produced in Adams, Arapahoe and Boulder Counties, generally downwind of Denver, a total loss of over 16 percent is forecast. This amounts to about $6,800,000.

Air quality is expected to improve insofar as ozone is concerned. If the same crop mix and dollar value is assumed for the next 25 years, and a 5 pphm threshold for crop damage is assumed, the dollar losses for 1985 and 2000 are forecast to be about $3,600,000 and $2,200,000, respectively. This amounts to about $95,000,000 over the 25 year period. If the future ozone levels were reduced by 20 percent, the loss over the 25 year period would be reduced 21 percent to $75,000,000.

WATER QUALITY

Three major alternative wastewater collection and treatment programs for the study area, the LOCAL, REGIONAL and NO-ACTION alternatives, were identified and discussed in Section III of this document. Ten 201 facilities plans and their respective planning areas, as shown on Map J, encompass the individual units of these three major alternatives and collectively serve the majority of the study area's stream basins, as discussed in Section II. The status of existing and proposed wastewater facilities is given in Table IV-P. The proposed 201 facility plans addressed in this EIS are underlined.

The following subsections will assess the likely water quality impacts and improvement in beneficial stream uses both for the implementation of these three major point source control alternatives and for feasible non-point source controls.

Background

Reviewing information presented in Section III, it can be noted that the local alternative is typified by the expansion and upgrading of existing facilities with satellite plants in the Cherry Creek, Clear Creek and lower South Platte basins, whereas under the regional alternative, the satellite plants would not be constructed and excess wastewater flows above the capacity of the upgraded existing facilities would be sent to the Denver Northside/MDSDD #1 complex. The no-action alternative is typically the same as the local one except for various time delays in the expansion and up-grading program. Under all the alternatives, the levels of treatment to be provided include additional removal of BOD_5 and suspended solids to effluent levels of 20 mg/l each, and reduction in effluent ammonia levels to approximately 3 mg/l. In addition, residual chlorine levels in the effluents will be reduced. The location and sizing/staging of the various wastewater collection and treatment facilities for the local and regional alternatives are shown in Figures III-A and III-B, respectively, and are discussed in greater detail in Section III.

The Federal Water Pollution Control Act Amendments of 1972 indicate that it is the national goal to meet by 1983 levels of water quality which provide for "protection and propagation of fish, shellfish and wildlife and provide for recreation in and on the water". The Act also declares as a national goal "that the discharge of pollutants into the navigable waters be eliminated by 1985".

The Colorado Water Quality Control Commission has classified the majority of the streams in the Denver region by category of beneficial uses and has established the water quality required to achieve and/or maintain those uses in accordance with the 1983 goals.

Table IV-P. STATUS OF EXISTING/PROPOSED WASTEWATER COLLECTION AND TREATMENT FACILITIES UNDER THE LOCAL, REGIONAL AND NO-ACTION ALTERNATIVES

Basin	Existing or proposed facility	Status under local alternative	Status under regional alternative	Status under no-action alternative
Bear Creek	Morrison	Assumed will maintain present level of secondary treatment but will add nutrient removal to reduce effluent ammonia (NH_3-N) to 3 mg/1	Same as local	Same as local but but ammonia removal facilities would be added at later date
Cherry Creek	Glendale	Assumed will maintain present level of secondary treatment but will add nutrient removal to reduce effluent NH_3-N to 3 mg/1 and reduce residual Cl.	Same as local	Same as local
		AWT plant to be built in 1985 only if feasible at that time. Effluent at secondary level when used for reuse (industrial/agri), tertiary when discharged to Cherry Creek. Flows above plant capacity sent to Denver/Northside/Metro #1 system	All flows sent to Denver/Northside/Metro #1 system (except Glendale) via Cherry Creek/Goldsmith Gulch interceptor	Same as regional but construction of interceptors delayed two years
Sand Creek	Aurora (Expand plant to 2 mgd)	Expanded/upgraded new facility to meet effluent levels of 20 mg/1 each for BOD_5 and suspended solids (SS) and NH_3-N to 3 mg/1. Residual chlorine (Cl) reduced to 0.05 mg/1 and fecal coliform (Fc) to 1000 MPG/100 ml. Effluent to Quincy Reservoir for reuse. Flows above plant capacity to Metro #1 via interceptor for treatment	All flows via interceptor to Metro #1 for treatment. Aurora plant abandoned.	Same as regional but construction of interceptors delayed three years
	Fitzsimmons	Plant abandon and flows sent to Sand Creek Satellite (Aurora new plant)	Plant abandoned and flows via interceptor to Metro #1 for treatment	Same as regional but construction of interceptor delayed three years.

Table IV-P. STATUS OF EXISTING/PROPOSED WASTEWATER COLLECTION AND TREATMENT FACILITIES UNDER THE LOCAL, REGIONAL AND NO-ACTION ALTERNATIVES (continued)

Basin	Existing or proposed facility	Status under local alternative	Status under regional alternative	Status under no-action alternative
Clear Creek	Coors	Assumed to be upgraded to meet secondary treatment levels with nutrient removal to reduce effluent NH_3-N to 3mg/l	Same as local	Same as local
	Clear Creek Satellite (also serving North Table Mtn., Applewood, Golden, and Pleasant View) (6.56mgd)	Assumed to construct AWT plant meeting effluent levels of 20 mg/l each for BOD_5 and SS, 3 mg/l for NH_3-N, residual Cl to 0.05 mg/l, and FC of 1000 MPN/100ml. Effluent levels may be more stringent depending upon discharge/reuse.	Flows via interceptor to Metro #1 for treatment	Local alternative delayed three years
	Wheatridge, Clear Creek Valley, Arvada, Crestview	Plants abandoned and flows via interceptor to Metro #1 for treatment	Same as local	Local/regional but construction of interceptor delayed three years
South Platte				
South Metro	Englewood/Littleton (20 mgd)	The Englewood and Littleton plant is expanded in capacity and NH_3-N and Cl removal facilities are added. 30 mgd in 1982, and 40 mgd in 1993. AWT effluent levels assumed at 20 mg/l each for BOD_5 and SS, NH_3-N of 3 mg/l and residual Cl at 0.01 mg/l	Existing plant upgraded to AWT levels (as shown in local alternative) with flows in excess of plant capacities sent to Denver/Northside/Metro #1 system	Addition of NH_3-N and Cl removal facilities at existing plant delayed till 1982. Expansion to 30 mgd delayed to 1986.
Middle	South Lakewood	Expand/upgrade to 3 mgd AWT plant and discharge to South Platte.	Abandon existing plant and transport all flows to Metro #1 interceptor/plant	Maintain existing plant with effluent sent to Metro #1 for further treatment.
Lower	Metro #1	No additional added capacity above 190 mgd. NH_3-N removal to various levels depending upon effluent discharge/reuse options	Capacity expanded to 260-270 mgd with NH_3-N removal to various levels depending upon effluent discharge/reuse options	Local alternative with further expansion beyond 1985 delayed
Northglenn	Northglenn (5 mgd pretreatment prior to storage or reuse for agricultural exchange)	All flows to new pre-treatment facility at Bull Canal Reservoir. All effluent used on agricultural exchange. 5 mgd by 1982.	All flows to MDSDD#1.	Same as regional alternative.

Table IV-P. STATUS OF EXISTING/PROPOSED WASTEWATER COLLECTION AND TREATMENT FACILITIES UNDER THE LOCAL, REGIONAL AND NO-ACTION ALTERNATIVES (continued)

Basin	Existing or proposed facility	Status under local alternative	Status under regional alternative	Status under no-action alternative
	South Adams County	Expand/upgrade existing plant to 6 mgd by 1986. Effluent at 20 mg/l each BOD_5 and SS, NH_3-N at 3 mg/l winter - 7 mg/l summer, and FC at 6000 MPN/100 ml. Residual Cl at 0.5 mg/l. Effluent discharge to Burlington Ditch.	Plant expanded to 3.75 mgd by 1978 but abandoned by 1985 with all flows to Metro #1.	Expansion to 4.25 in 1978. Final 1.75 mgd added in 1990.
	Lower South Platte Satellite Plant at 164th Avenue (8.7 mgd)	New plant to treat flows from Brighton; and 1st, 2nd, and 3rd Creeks. Effluent at 20 mg/l each BOD_5 and SS, NH_3-N at 3 mg/l, FC at 1000/100 ml, and residual Cl of 0.05 mg/l. Flows from Upper Thornton and NWSWDS to Metro #1. Flows from Lower Thornton used by Northglenn in agricultural exchange. Option to pump some of plant flow to Big Dry Creek plant.	All flows to Metro #1 except flows from Brighton; 1st, 2nd and 3rd Creeks to new plant.	Local alternative with construction of new plant delayed four years, and Lower Thornton flows to Big Dry Creek plant.
Big Dry Creek	Broomfield/Westminster	Big Dry/Westminster plant expanded upgraded to 9 mgd with 20 mg/l each BOD_5 and SS, NH_3-N at 1.0 mg/l, FC at 1000/100 ml, and residual Cl at 0.02 mg/l. Plant treats excess flows from Broomfield and flows from Westminster and some of Thornton. Discharge to either Farmers Highline Canal or Big Dry Creek.	Maintain current capacity of Big Dry/Westminster plant at 2.5 mgd. Maintain other plants at existing capacity and excess flows to Metro #1	Expand Big Dry/Westminster to 5 mgd with NH_3-N removal. Maintain other plants and excess flows to Metro #1.
Coal Creek	Erie, Lafayette, Louisville 1985: 0.4 mgd, 1.3 mgd, 1.3 mgd; 2000: 1 mgd, 2 mgd, 2 mgd	Expand/upgrade existing facilities to 20 mgd/l each BOD_5 and SS, NH_3-N at 3 mg/l, FC at 200/100 ml	Same as local	Same as local but expansion/upgrading delayed
Boulder Creek	Boulder/White Rocks 18 mgd	Add tertiary treatment via biological mechanical processes with discharge to Boulder Creek.	Same as local	Same as local

The DRCOG, in developing the Clean Water Plan, performed extensive reviews and investigations of current state stream classifications and water quality standards. Four alternative levels of classifications were established and the concomittant facilities, plans and cost required to meet each alternative level determined. The highest levels, Alternative Classification 1, are governed primarily by primary contact, cold or warm water biota and potable supply water uses. From Alternative Classification 1, the alternatives descend in levels of water quality to Alternative Classification 4 levels, which are primarily secondary contact, agriculture and wildlife uses and which generally represent present water quality. Through extensive review and public participation programs, recommendations were made as to the alternative classification level that was achievable and consistent with the 1983 goals for each portion of each stream. These recommendations were then incorporated into the Clean Water Plan. Both the current State of Colorado stream classifications and those recommended in the Clean Water Plan are shown in Table IV-Q.

A direct comparison between the current State of Colorado classifications and the classifications recommended by the Clean Water Plan is not straightforward. Generally, the headwaters of the streams are either recommended for continued high classification levels or upgraded. Downstream segments of the South Platte River and Clear, Coal and Boulder Creeks are downgraded and would no longer include maintenance of biota and, in some cases, public water supply uses. The Clean Water Plan recommended classifications have not been adopted by the State of Colorado as of March 1978.

Shown in Table IV-R are the current and proposed water quality standards considered as necessary and sufficient to meet the 1983 goals within the study area. The standards proposed by the Clean Water Plan have not been adopted by the State of Colorado as of March 1978, but are comparable to, or for some parameters more stringent than, the criteria proposed by the Colorado Department of Health.

The information presented in Table II-H of Section II of this volume, indicates that the only location within the study area that presently consistently meets the water quality criteria established in the Clean Water Plan to meet the 1983 goals presented in Table IV-Q for all seasons is the upstream reach of the South Platte, above Chatfield Reservoir. The upper portions of the remaining basins are, for the most part, well within proposed standards except for ammonia and phosphate during all seasons; and fecal coliforms, during the spring at Bear Creek/Morrison and Clear Creek/Golden. Thus, the background quality of water entering the major basins within the study area is generally high. However, as can be seen from the review of Table II-H, the water quality of the streams is degraded as they pass through the lower portions of their respective

Table IV-Q. CURRENT AND RECOMMENDED STREAM CLASSIFICATIONS BY STREAM REACH

Stream and Reach	Recommended Classification	Clean Water Plan Classification Level	Current State Classification
South Platte River			
Headwaters to Dartmouth Avenue	1,2,3,4,6,7,8	1	B1
Dartmouth Avenue to MDSDD#1 Outfall	2,3,8[a]	4	B2
MDSDD#1 Outfall to Weld County Line	2,3,8	4	B2
Bear Creek			
Headwaters to Mouth	1,2,3,4,6,7,8	1	B1 thru Morrison B2 remainder
Cherry Creek			
Headwaters to just above Reservoir	1,2,3,5,6,7,8	1	None
Cherry Creek Reservoir	1,2,3,5,6,7,8	1	A2
Cherry Creek Reservoir Outlet to Mouth	2,3,6,8	3	None
Clear Creek			
Headwaters to Golden (Farmer's Highline Diversion)	1,2,3,4,6,7,8	1	B1
Golden to Mouth	2,3,6,7,8[c]	3	B2
Sand Creek			
Headwaters to Mouth	2,3,8[b]	4	None
Big Dry Creek			
Headwaters to Standley Lake (inclusive)	1,2,3,5,6,7,8	1	None
Standley Lake Outlet to Weld County Line	2,3,5,8	3	None
Coal Creek			
Headwaters to Highway 93	1,2,3,4,6,7,8	1	B1
Highway 93 to Mouth	2,3,6,8	3	B2
Boulder Creek			
Headwaters to 75th Street Wastewater Treatment Plant Outfall	1,2,3,4,6,7,8	1	A1
75th Street Wastewater Treatment Plant Outfall to Coal Creek	1,2,3,5,6,7,8	1	A2
Coal Creek to Mouth	2,3,8	4	B2

Clean Water Program Classification Definitions
1 - Primary Contact, 2 - Secondary Contact, 3 - Agriculture
4 - Cold Water Biota, 5 - Warm Water Biota, 6 - Water Supply-groundwater,
7 - Water Supply - surface water, 8 - Wildlife

State of Colorado Classification Definitions

A1	Suitable for all uses, including domestic water supply, primary contact recreation (e.g., swimming), secondary contact recreation (e.g., boating), and cold water fishery.
A2	Suitable for domestic water supply, primary contact recreation, and warm water fishery.
B1	Suitable for domestic water supply, secondary contact recreation, and cold water fishery.
B2	Suitable for domestic water supply, secondary contact recreation, and warm water fishery.

Footnotes

[a] To consider potential water supply conflict with Brighton and Thornton.

[b] To consider water supply for South Adams.

[c] Alternative 1 to be kept open as an option.

Table IV-R. CURRENT AND PROPOSED WATER QUALITY STANDARDS TO MEET 1983 GOALS

Parameter	Units	Clean Water Plan Recommendations	Current Colorado Standards	Proposed Colorado Standards
Temperature	C			
Minimum for swimming		15	(a)	(a)
Maximum				
Cold water biota		20	20	20
Warm water biota		30	32	30
Swimming		35	(a)	(a)
Dissolved Oxygen	mg/1			
Cold water biota		5(b)	5	5
Warm water biota		7	6	6(c)
Total Dissolved Solids	mg/1	2,000	(a)	(a)
Fecal Coliform	MPN/100ml			
Primary contact		200	200	200
Secondary contact		200	1,000	1,000
Fecal Streptococcus	MPN/100ml			
Primary contact		(a)	20	(a)
Secondary contact		(a)	(a)	(a)
Chlorine Residual	mg/1			
Cold water biota		(a)	(a)	0.002
Warm water biota		(a)	(a)	0.01
Ammonia (NH_3-N)	mg/1			
Cold water biota	(un-ionized)	0.02	(a)	0.02
Warm water biota		0.02	(a)	0.10
Phosphate	mg/1	0.1	(a)	(d)
Nitrate/Nitrite	mg/1	(a)	(a)	10/1(e)

a. No numerical standard given.
b. Concentrations of dissolved oxygen are minimums allowed.
c. A 7 mg/1 standard will be set during periods of spawning of coldwater fish.
d. Numerical criteria will be established for specific waters to prevent degradation such as to prevent noxious algal blooms or over-eutrophication.
e. Values are for nitrate and nitrite respectively to protect domestic raw water supply. Values for livestock water supply are 100 and 10 mg/1 respectively.

basins. For all locations, temperature criteria are met, on the average by season, except during the winter, when the proposed Clean Water Plan standard for swimming is exceeded. However, this activity is unlikely to occur during the winter season. Dissolved oxygen levels are still relatively high throughout the major basins during all seasons, with the exception of South Platte above Littleton during the summer. This may in part be due to the release of low-level dissolved oxygen waters from Chatfield Reservoir during the summer months, the reason for which is unknown at this time. Levels of total dissolved solids, although below the suggested levels for the 1983 goals in all major basins, do tend to increase substantially from upstream levels in any basin. Average ammonia levels exceed proposed state standards for current stream classifications in Sand Creek and the lower South Platte year round, and in the downstream reaches of the other streams during winter. High levels of ammonia during runoff events may be caused in part by animal grazing in the plains east of Denver and in the hills west and south of Denver. The Clean Water Plan recommends a numerical standard for phosphate, but the State of Colorado is proposing that numerical criteria be based upon a case-by-case examination of the significance of phosphate to specifically identified water quality problems. Under the Clean Water Plan recommended standard, phosphate presents a problem year round in Denver region streams. Current and proposed Fecal Coliform Standards are exceeded year round in Sand Creek and in the lower South Platte and in all streams during runoff events.

It is within this general context that the three major wastewater collection and treatment alternatives in this report were developed and will be analyzed in the following subsection. Also, their likely impacts upon water quality and the likelihood of their meeting or approaching the 1983 water quality goals within the context of the Clean Water Plan for control of non-point sources of pollutants will be analyzed. The status of existing or proposed wastewater collection and treatment facilities within the study area's stream basins is indicated in Table IV-P. In addition, it should be noted that there is the likelihood that wastewaters from the City of Golden will be treated at an advanced waste treatment (AWT) facility, which would allow the City of Golden the option of reusing the effluent in the upper portion of Clear Creek.

The Local Alternative

The upgrading of the Morrison Sewage Treatment Plant (STP) to provide ammonia removal is expected to provide some reduction in the point source loading to Bear Creek. However, as can be observed in Table II-I, point sources do not account for a significant portion of the ammonia loading in the basin, particularly in the upper reaches. It appears necessary to provide a fairly high degree of non-point source control in order to reduce loadings of all constituents which are adversely affecting the Bear Creek Basin, as can be noted in Table II-H.

On Cherry Creek, above the reservoir, the option for an AWT plant exists. This plant would have a very high level of treatment when discharging to Cherry Creek and thence to the reservoir. However, this would occur only during the non-irrigation seasons. At other times, effluent would only be treated to the levels necessary for agricultural irrigation reuse. In theory, if additional flows into the reservoir during winter were equalled by additional downstream discharges from the reservoir, the flow in Cherry Creek would about double in 1985 and increase another 50 percent in 1995. However, any augmentation of creek flow would be limited to winter months, this additional flow, coupled with ammonia removal at the Glendale plant would improve water quality levels throughout lower Cherry Creek, but phosphate may present a problem. Beneficial uses of secondary contact recreation would be restricted to that portion of Cherry Creek between the reservoir and Glendale, as the remainder of the creek is channelized with access-limiting, vertical concrete walls.

The provision of AWT facilities at the present Aurora STP site is expected to result in a significant reduction in point source loadings of ammonia in Sand Creek. However, by removing the effluent flows to the stream and transferring water to Quincy Reservoir, it appears that stream flows in Sand Creek would then be too low to provide secondary contact recreation opportunities. The question of water rights and transfer appears to be of major importance in this basin because it is likely that stream flows necessary for secondary contact recreation would occur only during the spring season, when storm runoff augments the base flows.

The provision of AWT facilities on Clear Creek (Golden and satellite plants), along with improved treatment at Coors and the removal of effluent flows at the STP's in the lower portion, would vastly improve the water quality of Clear Creek. As indicated in Section II (Existing Water Quality), this basin is significantly impacted by point source loadings, particularly by BOD_5, ammonia and phosphate. No standard exists for phosphate although the Clean Water Plan recommends a standard of 0.1 mg/l. If the Colorado Department of Health finds that phosphate is contributing to water quality problems on Clear Creek, a numerical limit may be set under proposed state regulations. If the Clean Water Plan recommendation is adopted by the State, phosphate removal from point discharges to Clear Creek would be necessary.

Another major problem area, the portion of the South Platte, between Littleton and 38th Avenue, would be alleviated by the upgrading of treatment at the Littleton and Englewood joint plant at Englewood. As was noted in Table II-H, point source loadings in this portion of the South Platte are significant with regard to BOD_5, ammonia and phosphate. Once again, however, the need for phosphate removal in addition to planned reductions in BOD_5 and ammonia will depend upon findings by the Colorado Department of Health.

Within the middle portion of the South Platte, the expansion and upgrading of the South Lakewood STP will have a positive, although less significant, impact upon improving water quality in the South Platte. The removal of ammonia from the plant's effluent would benefit the South Platte waters. This portion of the South Platte is clearly dominated by non-point sources for all water quality parameters (see Table II-H), and any additional expenditures at the South Lakewood STP for secondary treatment with ammonia removal would not be likely to prove cost-effective. Highly effective non-point source controls would be needed to achieve 1983 goals.

Within the lower South Platte, existing water quality is most clearly dominated by point sources, and most particularly by MDSDD #1. The upgrading of effluent quality at MDSDD #1 and South Adams County STP's would improve water quality above Henderson, and the satellite plant serving the Brighton area would also have a positive impact below Henderson. However, because of the very substantial contribution of loadings from MDSDD #1, particularly in total dissolved solids, BOD_5 and ammonia, it appears that diversion of a sizeable portion of MDSDD #1's effluent to Burlington Ditch for irrigation reuse would not only have a greater positive effect upon water quality in the South Platte, but might also be cost-effective in terms of the cost of higher levels of treatment.

Under the local alternative, the remaining facilities in the Big Dry, Coal and Boulder Creek basins are to continue discharging to their respective streams with high levels of effluent quality for protection of stream quality. The options to discharge a portion of the effluent from Big Dry STP to the Farmer's Highline Canal, and all the treated wastewater flows from Northglenn to the Bull Canal for reuse as irrigation water appear to be better uses of the basin's water (Reference 261). Provided cost effectiveness can be demonstrated and the necessary transfer of water rights can be arranged, the Big Dry Creek option also appears to best protect the water quality, however, some small stream flow reduction is likely.

From an evaluation of information presented in Table IV-P and from the Wasteload Allocation Report (Reference 261), it appears that the levels of point source treatment proposed in the local alternative may provide stream water quality which would approach the stream classification levels recommended in the Clean Water Plan. The gap between desired and actual water quality would be even greater if the comparison is made with current state classification levels which are higher than those recommended in the Clean Water Plan for the downstream reaches of most streams. This conclusion would be more favorable if the comparison were restricted to average stream flows, sizeable portions of MDSDD #1's effluent were diverted to the Burlington Ditch, and the Clear Creek and Cherry Creek satellite plants were designed to produce effluent at quality levels sufficient for desired stream water quality. Regardless of of point source treatment levels, neither current nor recommended stream classifications pursuant to the 1983 goals can consistently be met because of non-point pollution.

The Regional Alternative

In the Bear, Cherry, Sand and Clear Creek basins, only the Morrison, Glendale and Coors STP's would be upgraded, while all other wastewater would be transported for eventual treatment at MDSDD #1. However, the resultant reductions in base stream flow in Cherry Creek would likely reduce the potential for secondary contact recreation to the spring season alone, when non-point source control would become necessary. In the Clear Creek basin, the reduction in streamflow might impair water rights. The overall impact would be the basinwide reduction in Clear Creek's base flows, resulting in a greater need for non-point source controls within the basin than might otherwise be necessary to compensate for the loss of dilution available with higher base flows.

With the portion of the South Platte immediately below Littleton, the existing Littleton and Englewood joint STP would be upgraded and all flows in excess of the plant's capacity would be sent to MDSDD #1. There would be reductions in point source loadings, particularly with regard to ammonia and BOD_5, and the transport of excess flows to MDSDD #1 would further reduce the impacts of point sources on the water quality of the South Platte in this area.

By transporting all domestic wastewaters from the middle portion of the South Platte to MDSDD #1 for treatment, the impact of point sources would be removed. However, as can be noted from Table II-I, the major contribution of pollution in this portion of the South Platte stems from non-point sources. Recognizing that non-point source pollution would probably occur more frequently during the spring, the improvement in water quality for the South Platte in this area would likely be more noticeable during the summer season. Loss of the discharge from South Lakewood would be insignificant as it would contribute only 10 percent of low flow in the South Platte. This, coupled with the provision of South Platte stream-bank parks, would increase the opportunity for secondary contact recreation during the summer, particularly if upstream water quality improved in the portion of the South Platte immediately below Littleton.

With MDSDD #1 expanded to handle all the flows diverted from the other basins, the lower South Platte basin would experience the flow of a very large point source at its upper portion, with other point sources downstream, except for Brighton, from MDSDD #1 eliminated. This configuration, as compared to the local alternatives of three smaller point sources located along the South Platte from Commerce City to Brighton, might result in considerably reduced stream water quality in a stretch of the South Platte below MDSDD #1, although there would be some downstream recovery. The local alternative could provide a more uniform level of water quality than the regional alternative. The extent and degree of reduced water quality in this reach under the regional alternative, is unknown at this time. It is likely, however, that under the regional alternative equal or greater consideration would have to be given to discharging a significant portion of MDSDD #1's effluent to Burlington Ditch. This may be necessary not only to protect water quality and downstream water supply uses of the South Platte, but also to reduce the sizeable expenditure of funds that may be necessary to produce an effluent acceptable for stream discharge. This remedy could be limited, however, because nutrient loads in Barr Lake would be increased as a result and over eutrophication may occur.

The configurations and probable water quality impacts for Coal Creek and Boulder Creek would be the same as for the local alternative, i.e., the improvement of water quality in streams, whose base flows come principally from STP effluents. However, the option of reusing effluent from the Big Dry Creek STP for irrigation purposes in the Farmer's Highline Canal is not included in the regional alternative, and basin flows are transferred to MDSDD #1, rather than being utilized to maintain streamflows in Big Dry Creek. Unlike the local alternative, there have been no definitive studies with regard to the overall impact of the regional alternative on the study area's water quality. The individual stream basin impacts of the various facility plans have been discussed above and the overall impact may be assessed in general. Under the regional alternative, most point sources are removed from the Sand, Clear and middle South Platte basins, thus reducing their pollution impacts upon these streams (Table II-I). However, doing so, the basins are rendered more susceptible to fluctuations in base flow and to influences of non-point sources which, as noted in Section II, are significant within the study area. It is therefore likely that the control of non-point sources in these basins will become more important in the effort to approach 1983 water quality goals. The impact of point sources in the lower South Platte becomes more important for MDSDD #1 than in the local alternative, as discussed above. It is likely that in order to approach 1983 water quality goals for the lower South Platte, MDSDD #1 either would have to provide a very high level of treatment or would have to divert a very significant portion of its effluent to the Burlington Ditch.

The No-Action Alternative

As can be noted from Table IV-R, the overall status of the no-action alternative is to maintain the existing plant configurations for the next several years. After this time, flows in the Sand and Cherry Creek basins and in the lower portion of Clear Creek basin would be sent to MDSDD #1. Satellite plants would be constructed in the Clear Creek and lower South Platte basins and the Big Dry Creek plant would be expanded to handle more of its basin's wastewaters. The South Lakewood plant would send its effluent to MDSDD #1 for further treatment; the Englewood/Littleton facilities would eventually be expanded; and the South Adams STP would be expanded to handle more of its basin's wastewaters.

The immediate impact of this alternative is the continuing degradation of water quality in the upstream portions of the streams of the study area, and the maintenance of the status quo on the remaining portions. Following the period of upgrading, expansion and routing of wastewater flows, as described earlier, the impact of point sources in the basins within the study area would be reduced, particularly in the Sand, Cherry and middle South Platte basins.

Although no rigorous assessment of the stream water quality that will result from the implementation of this alternative is available, it appears that the alternative does combine some of the best features of the two previous alternatives. There is not such a heavy reliance upon treatment of most wastewater flows at MDSDD #1; the Big Dry Creek basin maintains its option of irrigation reuse of its effluent; point sources are treated in the South Metro portion of the South Platte; and the impact of point sources in the lower South Platte is reduced and spread out rather than being concentrated in one portion. However, point sources will still contribute to water quality problems in the upper portion of the Clear Creek basin unless treatment levels at the satellite plant are such that either some form of effluent reuse can be implemented or downstream water quality is protected. Under this alternative, non-point sources become the influencing factor in the Sand, Cherry and middle South Platte basins. It is likely that resultant stream water quality within the study area under the no-action alternative will approach that of the local alternative, but at a later time.

The principal differences between the no-action alternative and the local alternatives are a likely delay of 3 or more years in the implementation of point source water quality improvements with the burden of paying for these improvements shifted to local government and local taxpayers.

Summary

Utilizing information from Section III and Reference 261, Table IV-S indicates the anticipated 1985 non-point source loadings by basin and the resultant point source loadings within the same basins after implementation of each of the three major alternatives. It should be noted that the point source loadings assume discharge to the representative creeks. The exceptions are the Sand Creek satellite plant, as mentioned previously, which will discharge its effluent to Quincy Reservoir or reuse it for urban irrigation under the local alternative, and the Boulder STP, which is assumed will discharge to percolation ponds or otherwise discharge a high quality effluent. The levels of treatment for the wastewater facilities were noted in Table IV-R, except for MDSDD #1, which is assumed to discharge a secondary level effluent, i.e. BOD_5 of 30 mg/l and ammonia of 3 mg/l. Phosphate levels in all treatment plant effluents are assumed at 8 mg/l. The Boulder STP is assumed to have a negligible effect on Boulder Creek.

It can be seen by comparing Tables IV-S and II-I that non-point sources of pollution are expected to increase throughout the study area by approximately 49 percent for each of the parameters shown in Table IV-S. This increase is a direct consequence of further urbanization in the Denver region. Those basins with the largest projected non-point source loading increases are Bear Creek (200 to 220 percent), Cherry Creek (BOD_5 and phosphate 75 percent, ammonia 100 percent), Clear Creek (60 percent), and lower South Platte (70 percent). Pollutants from point sources would also be expected to increase as a result of growth, but treatment by wastewater treatment plants may negate or offset growth effects, thus pollutant loadings from point sources may be minor compared to non-point loadings. For example, by 1985, on Clear Creek under the local alternative, the non-point loading for BOD_5 will increase by 60 percent, whereas the point source loading will decrease 30 percent compared to 1972. Thus, while point sources dominate total loadings in the Clear Creek basin in 1972, non-point loadings will dominate in 1985. This would be true even if non-point loadings were reduced by one-third under an effective non-point source control program.

An examination of the total basin-wide loadings in Table IV-S indicates that the majority of BOD_5, ammonia, and phosphate will originate from point sources. However, if those loadings in the lower South Platte, principally from the Denver Northside/MDSDD #1 complex are deleted, only phosphate will still be dominated by point sources. All other pollutants are dominated by non-point sources. It must be remembered that, non-point sources of pollutants in most cases only affect water quality when they enter a stream via some runoff event such as snowmelt or precipitation. Thus, their contribution is not constant as are the contributions from point sources.

Table IV-S. ANTICIPATED POINT AND NON-POINT SOURCE LOADINGS IN THE YEAR 1985, BY STREAM BASIN (pounds per day)

	BOD_5				TDS			
	Nonpoint source	Point source			Nonpoint source	Point source		
Basin		Local	Regional	No-action		Local	Regional	No-action
Bear Creek	2,900	18	18	18	246,500	410	410	410
Cherry Creek	4,300	1,430 (430)	100	100	268,500	55,600	8,900	8,900
Sand Creek	7,200	0	0	0	578,000	0	0	0
Clear Creek	6,600	3,350	2,300	3,350	554,000	98,300	60,100	98,300
South Platte								
South Metro	3,900	5,470	4,900	5,470	324,200	132,800	113,000	132,800
Middle	10,000	370	0	0	851,000	12,000	0	0
Lower	7,200	37,705	47,700	38,300	548,000	944,100	1,160,000	960,000
Subtotal	42,100	48,343 (47,343)	55,018	47,238	3,470,200	1,243,210	1,342,410	1,200,410
Big Dry Creek	2,800	820	900	830	227,000	28,600	21,000	29,200
Coal Creek	2,000	500	500	500	175,300	17,500	17,500	17,500
Boulder Creek	5,500	-	-	-	463,500	-	-	-
Total	52,400	49,663 (48,663)	56,418	48,568	4,336,000	1,289,310	1,380,910	1,247,110

Table IV-S. ANTICIPATED POINT AND NON-POINT SOURCE LOADINGS IN THE YEAR 1985, BY STREAM BASIN (pounds per day) (continued)

	NH_3-N				PO_4			
		Point Source				Point Source		
Basin	Nonpoint source	Local	Regional	No-action	Nonpoint source	Local	Regional	No-action
Bear Creek	235	2	2	2	210	5	5	5
Cherry Creek	360	225 (90)	25	25	320	600 (87)	70	70
Sand Creek	560	0	0	0	530	0	0	0
Clear Creek	540	390	225	390	490	1,560	1,130	1,560
South Platte								
South Metro	280	575	490	575	280	1,470	1,240	1,470
Middle	800	55	0	0	750	150	0	0
Lower	540	3,850	4,770	4,290	530	10,300	12,700	10,400
Subtotal	3,315	5,097 (4,962)	5,512	5,282	3,110	14,085 (13,572)	15,145	13,505
Big Dry Creek	230	100	90	125	200	330	240	330
Coal Creek	170	75	75	75	150	200	200	200
Boulder Creek	440	-	-	-	410	-	-	-
Total	4,155	5,272 (5,137)	5,677	5,482	3,870	14,615 (14,102)	15,585	14,035

Note: Values in parenthesis for Cherry Creek - Local Alternatives are those resulting from high levels of tertiary treatment at the Cherry Creek Satellite plant.

Nevertheless, the Bear, Cherry and Sand Creek basins, as well as the portion of the South Platte flowing through Denver proper, are dominated by non-point sources of pollutants now and will continue to be in 1985. Non-point sources would remain dominant even if a 35 percent reduction of non-point loadings, as proposed in the Clean Water Plan through nonstructural controls, were achieved in 1985. The upstream portion of the South Platte would be dominated by point sources, namely Littleton-Englewood, for BOD_5, ammonia, phosphate and TDS. The Clear Creek basin will become dominated by non-point sources for BOD_5 and ammonia, but will remain dominated by point sources for phosphate and TDS. A 35 percent reduction in non-point sources, as contemplated in the Clean Water Plan, would not change this conclusion except that the contributions of ammonia would be about equally balanced between point and non-point sources.

One particular point should be noted: in the local alternative, the Cherry Creek satellite plant would appear to contribute significant loads of BOD_5, ammonia and phosphate to its basin if the effluent is to be discharged year-round. The plant's discharge levels assumed under this alternative for these parameters were 20, 3 and 8 mg/l, respectively. Were these levels reduced to 5 mg/l BOD_5, 1 mg/l ammonia and 0.3 mg/l phosphate (tertiary treatment level 14, as noted in Reference 262), the Cherry Creek basin point source loadings would be reduced to 195 kilograms (430 pounds) per day BOD_5, 40 kilograms (90 pounds) per day ammonia, and 39 kilograms (87 pounds) per day phosphate. It is therefore likely that the incorporation of tertiary treatment at the Cherry Creek satellite plant, with the effluent discharged only during the winter non-irrigation season, would significantly enhance the quality and quantity of flows in Cherry Creek.

There are two basic approaches to reducing the impact of MDSDD #1's discharge on the lower South Platte. First is to reduce the amount of the discharge, and second is to improve effluent quality with higher levels of wastewater treatment. The first approach is a limited possibility in that increased amounts of effluent may be diverted to agricultural irrigation via the Burlington Ditch during the irrigation season. If the amount of effluent discharge to the South Platte were reduced to 0.66 cubic metres per second (15 million gallons per day) under the local and no-action alternatives or 1.10 cubic metres per second (25 million gallons per day) under the regional alternative, point sources for BOD_5 and ammonia would then be comparable to non-point sources during the irrigation season. However, point sources of phosphate, a potential contributor to water quality problems, would still be two to three times non-point loadings. In addition, additional diversions to the Burlington Ditch would increase nutrient loadings to Barr Lake and probably increase existing eutrophication problems.

The upgrading of effluent discharge quality at MDSDD #1 through tertiary treatment to levels of 5 mg/l BOD_5, 1 mg/l ammonia, and 0.3 mg/l phosphate, would have the following results in the lower South Platte Basin. Under the local and no-action alternatives, BOD_5 loadings from point sources would be comparable with non-point loadings. Point sources for ammonia and phosphate would be two and three times non-point loadings. Under the regional alternative, point sources would still greatly dominate.

As mentioned previously, the implementation of any of the three major wastewater collection and treatment alternatives is likely to result in improved in-stream water quality enabling the use of stream waters for secondary-contact recreation and protection of warm-water biota most of the time. Present study area water quality levels in downstream reaches are generally consistent with secondary-contact and recreation uses. Clean Water Plan investigations of wastewater treatment alternatives concluded that the improvement in the percentage of time that water quality sufficient to maintain a warm water fishery in the South Platte downstream of Littleton could be maintained, did not justify the cost of high level secondary treatment of wastewaters. Thus, maintenance of a warm water fishery in the lower South Platte was not recommended as a water quality goal and normal secondary level treatment was recommended. This difference in treatment level is the major difference between the local alternative and the recommendations of the Clean Water Plan. The Clean Water Plan generally recommends an effluent quality of 30 mg/l suspended solids and BOD_5, whereas the local alternative generally assumes 20 mg/l suspended solids and BOD_5 with varying degrees of ammonia removal. The effluent quality under the local alternative is derived from facility plans which respond to current state, rather than Clean Water Plan recommended stream water quality goals. Regardless of treatment level, neither current or recommended stream classifications can be met year-round by point source controls alone. The implementation of the regional alternative is expected to increase the percentage of time water quality criteria are met in the Cherry, Sand and Clear Creek basins and to decrease it in the lower South Platte (MDSDD #1 to Weld County line).

In the metropolitan area, the effect of non-point sources on the attainment of recommended stream standards is significant. Non-point source problems appear to be more pronounced in the Sand, Cherry and middle South Platte basins and, to a lesser extent, in the lower portions of the Bear and Clear Creek basins. The Clean Water Plan has identified two major parameters, phosphate and fecal coliform, from non-point source runoff that could constrain the attainment of the "swimmable" criterion for Front Range streams without some form of non-point source control. Assuming advanced treatment of the point sources, there are fewer water quality limitations to attaining the "fishing" and non-contact recreation criteria, as shown in Table IV-T.

Table IV-T. CONTROL REQUIREMENTS FOR POINT AND NON-POINT SOURCES

Pollutant	Principal Stream Use Affected	Control Requirements
Phosphate	Body Contact	Will likely require a combination of point and non-point source controls
Ammonia	Fishery	Can currently only be effectively removed from point sources.
Nitrate	Water Supply Fishery	Can be most effectively controlled at point sources.
TDS	Agriculture Water Supply	Can be effectively controlled through non-point source programs.
Fecal Coliform Fecal Streptococci	Body Contact	Must be approached from both point and non-point sources together.
Dissolved Oxygen levels (BOD, nitrification)	Fishery	Largely a function of point source control on a sustaining basis and of non-point source control for storm-related events. Non-point source control cannot make up for a lack in point source control.
Chlorine	Fishery	Point source control.

It has been noted in the Clean Water Program studies and confirmed in this analysis that even the most stringent control of effluent quality from point sources will not be sufficient to meet 1983 water quality goals, and that significant non-point source control will be necessary.

GROWTH-INDUCED IMPACTS ON THE REGION'S ENVIRONMENTALLY SENSITIVE AREAS

Wastewater collection and treatment is one of several basic services local government provides to serve the needs of its citizens. Planning to accommodate a future population and its need for wastewater treatment and disposal is a prudent and responsible function exercised by local governments. Construction and operation of these facilities in accordance with plans to accommodate future growth must be considered a contributing factor to the environmental consequences of future growth. The same is true for other services, such as highways, schools and water supply. On a regional basis, it is rare that the provision or lack of a single "municipal" service stimulates or constrains regional growth, and thus it is rare that a single service can be considered the dominant factor in growth-related environmental impacts. However, a single service, particularly wastewater collection and treatment, can influence development patterns. The purpose of this section is to summarize the impacts of changes expected to occur in the region as a result of the population increases and resultant development patterns projected for the year 2000, for which the facility plans and the Clean Water Plan were developed.

Climate

Construction activities randomly located throughout the region will often be a factor in the local severities of Chinook wind episodes by providing particulates that can be blown downwind from construction sites to affect traffic, equipment operation, structures and crops. The significance of this impact will range from that of a nuisance to that of a hazard. Further development in the wind corridors of the South Platte River and Clear Creek valleys will increase the potential for wind damage in these areas. Early morning radiation fog traffic problems, ranging from slow-downs to chain-reaction accidents, will increase as traffic volumes continue to grow in response to suburban growth.

Geology

Grading of undulating natural landscapes for urban development can drastically modify landforms, change drainage patterns and alter visual appearances. Grading impacts can be especially significant in a local area where massive cuts and fills are made for road-building and hillside terracing, and in floodplains where protective devices such as channelization, diversions and in-stream structures are constructed. On a regional scale, these activities are likely to have cumulative impacts on water quality. However, gross land form characteristics will not be radically altered. Urban development will occur near unique and significant geological structures and formations, threatening many of them with over-use and vandalism. The region's geological hazards to development are generally local in nature and do not pose any region-wide threats to urban expansion.

Soils

Many farmers on the Colorado plains have turned under winter wheat crops due to low prices and drought conditions, leaving the dry ground surface exposed to the season's high velocity winds. Wind erosion can significantly reduce or destroy land's agricultural production capabilities. In terms of soil loss, however, water erosion is usually a more significant regional impact of urban expansion than wind erosion. Construction sites left exposed to precipitation and run-off experience sheet erosion, rilling and, at times, gullying. All of these can clog drainage improvements; alter the drainage net through additional streambank scouring, turbidity, siltation and sedimentation; increase receiving water temperature; and reduce chemical and biological water quality. These impacts, as discussed in the preceeding "Water Quality" section, can have cumulative long-term impacts on the region's drainage basins and water quality.

Hydrology

Urban expansion can impact sensitive hydrologic features including wetlands/marshes, floodplains, ground water and lakes in three main ways. These are: (1) encroachment into or elimination of the feature, (2) change in the amount and distribution of water flowing to or through the feature and (3) change in the quality of water flowing to or through the feature.

Grading and construction of buildings, roads and bridges can encroach into or eliminate wetlands/marshes, lakes and natural floodplains. The proximity of development can affect both the flora and fauna of the hydrologic element. Development can alter the extent of the flood hazard area limits through alteration of the conveyance capacity of the natural water course. Unwise occupation of the floodplain can seriously increase the potential for flood damage.

Development can cause an increase in the base flow of water reaching wetlands/marshes, lakes and floodplains, and the flora and fauna may be affected. Lawn irrigation return flow, interception of the ground water by storm and sanitary sewer systems, and leaky water distribution systems may be responsible for increased flows. Development may cause a decline in the recharge to the ground water table through occupation of a recharge area, such as that in the southwest portion of the region, through decreased infiltration because of impervious cover, and through elimination of agricultural irrigation in the area. Development tends to increase the peak rate, volume and frequency of flooding both within and outside the floodplain. The extent of increase tends to be larger for the more frequent floods than for rarer ones. These changes can cause greater erosion within steep floodplains and may affect the vegetation that can be maintained.

Development is likely to produce a decline in quality in waters reaching the hydrologic features. This can result from automobile wastes, fertilizers, pesticides, sewage and sediment. Poor water quality greatly speeds up the natural eutrophication process of lakes and can affect the flora and fauna of lakes, wetlands/marshes and floodplains.

Various hydrologic features, such as floodplains, lakes, ground water, or marshes, can also affect development. Any floodplain development can be unwise, particularly along those stretches of the upper portion of Bear Creek, Clear Creek and the upper portion of the South Platte River, all of which experience periodic flashflooding. The aesthetic quality of lakes may provide interesting focal points around which developments are planned. However, urban runoff is frequently the cause of eutrophication problems in such lakes. A reliable ground water supply may be one consideration in the feasibility of particular developments. Wetlands/marshes within the study area are generally not viewed as assets, and thus may affect development through creation of the need for drainage projects to dry them up.

Biology

The conversion of rural lands to urban uses typically requires flood control measures for local watercourses. Channel straightening, removal of riparian vegetation, paving of streambanks and colonization by weeds severely reduce habitat diversity. The soils erosion impacts, discussed earlier, affect aquatic habitats by filling in the rough stream channel bottoms with silt which eliminates the physical niches necessary to benthic organisms, thus eliminating the organisms themselves. Continuing and future aggregate mining, necessary to construction activities, is likely to entail channel disturbances and modifications, streamside vegetation removal, and discharges of wash water from gravel processing operations. Construction across riparian zones severs the continuity of this habitat, thereby disrupting wildlife movements through it. Development around pond and marsh areas often disturbs the local habitat quality. The opening of rural areas and wildlands for residential and increased recreational uses creates pressures on wildlife and their habitats.

Development along the foothills and mesa areas may infringe upon critical wintering areas typically used by deer and elk. Some curtailment of deer and elk feeding range may occur in the eastern boundary near Cherry Creek Reservoir and to the west in Douglas County. Animal and bird migrations through the lower foothills area may also be disturbed. As indicated on Map F, several areas have been recognized as ecologically significant due to unique geologic formations, soil types, plant and animal communities, and other factors. Development and recreation pressures on these areas may not only degrade the habitats or affect the surrounding environments, but may also reduce cumulatively the overall environmental quality of the region. Areas of particular concern, due to urban expansion, as noted by comparisons of the Projected Land Use Map (Map I) and the Biologically Sensitive Areas Map (Map F), are: (1) the Nature Conservancy in northwest Denver, (2) the Ken Caryl-Johns Manville Ranch, (3) the Marshall Mesa and (4) the White Rocks area near Boulder.

Human activities greatly increase the wildfire potential, particularly on slopes of 30 percent or greater where the fire hazard is critical. Construction and maintenance activities on steep slopes and the resultant slash, felled trees and other inflammable litter significantly increase this potential.

Energy

The 1975 population of the Denver region constituted about 57 percent of the population of the State of Colorado. By 1985 it will constitute perhaps 60 percent, and by 2000 about 54 percent of the state population. The Denver region's share of statewide energy consumption is estimated to be on the order of 64 to 68 percent at the present time. Natural gas shortfalls, amounting to 15 to 20 percent within five years, are expected to begin in the Denver region during 1978-79. The demand for natural gas by the Denver region may adversely affect the rural areas of Colorado, as rural areas are dependent on liquid propane which is manufactured from natural gas. There will be an increased reliance on and demand for electric power. After 1980, if scheduled power plants are delayed significantly, some brown-outs or load reduction and shedding will occur.

The increased demand for electrical power will probably be met with coal-fired power plants, which will increase Colorado's coal production. Between 1977 and 1985, the Public Service Company of Colorado plans to build or participate in building coal-fueled generators in Fort Morgan, Southeastern Colorado and Craig. The Craig plant is scheduled to burn Colorado coal, while Wyoming coal is to be used in the other generating facilities. Consequently, beginning in the 1980's, conflicts may arise over available water supplies between municipal and agricultural water users in the Denver region, due to increased demand for water for energy, statewide. (Reference 970)

Regional demand for petroleum-based fuels will increase with increased population. This increased demand will be limited to some degree by increased vehicle fuel economy and higher fuel prices. Although there will still be a net increase in consumption, petroleum-based fuels will be smaller part of overall basic fuel use.

Aesthetics

Growth in the Denver region could lead to a degradiation of many qualities which have created Denver's attractiveness and desirability. Some of the qualities that could probably be adversely affected include: (1) open spaces, wetlands and other natural areas, (2) wildlife, (3) scenic views through high-rise construction and air quality related visibility obstructions, (4) air quality, (5) noise levels, and (6) relaxed lifestyle.

Outdoor Recreation Sites

Regional growth will require development and recreation sites beyond those acquired to date. The growing needs of the populace will not be met as the land area per capita for parks will decrease 36 percent from 6 hectares (15.2 acres) per 1,000 persons in 1970 to 4 hectares (9.9 acres) per 1,000 persons in 2000. Park overuse and facility vandalism will continue and intensify throughout the region particularly in those areas having a high percentage of children and young people. This will be especially true in new suburban areas where there is a general predominance of young families. As these suburban areas age, the populations should begin to mature and the incidences of vandalism should somewhat decrease.

Land Waste Treatment Sites and Wastewater Reuse

Until a decision is made on the West Adams County sludge disposal site, the Lowry Bombing Range sludge disposal activities will continue, and existing problems could worsen due to high sludge application rates. However, the anaerobic digesters now under construction at MDSDD #1 will reduce the short-term possibility of a worsening situation. If the West Adams County site is not approved due to unforeseen environmental or legal problems, some new disposal scheme for the Lowry site might be adopted which could continue the present controversy. This controversy has resulted from a basic conflict between the established disposal use and the adjacent and growing residential uses.

As was indicated in an earlier discussion, development of new land application systems for wastewater treatment under the ownership and operational control of Denver area sanitation districts is considered difficult. Monetary costs of land acquisition and water rights problems have made these systems appear unfavorable by comparison to conventional treatment. In some cases the wastewater operating agencies, such as MDSDD #1, do not have ownership of the waters they are treating. Therefore, implementation of a MDSDD #1 operated land application system presents innumerable institutional difficulties.

Development of new lands for irrigation also runs afoul of existing water rights. For a municipality owning tributary water, a land application system that consumed additional South Platte water would require the purchase of additional water by the municipality to "make up" the lost consumed water. Cities that own West Slope non-tributary water do generally have the right to reuse the water.

From EPA's perspective, water quality benefits are paramount, especially where potential construction grant funding is involved. From the point of view of the municipalities, the most financially beneficial use of these waters and development of new domestic water supplies may be the most important criteria. From the perspective of downstream irrigation, water supplies should be neither diminished in quality or quantity. Additionally, state water quality priorities have favored protection of high-quality mountain streams (most of which are on the Western Slope) over plains streams that vary widely in seasonal flow and have been heavily contaminated by municipal and agricultural use. Thus, defining water quality and supply "benefits and impacts" is no easy task.

A number of important interrelated considerations must be kept in mind in discussing reuse potential in the water-short Front Range area:

- The region is still growing rapidly in population. Considerations of new municipal water supplies for growth is necessary.

- All of the water now in the South Platte basin is being used; in fact, successive use in the rule downstream to the Nebraska border.

- New supplies of water can come from the West Slope only through trans-basin diversions. Municipal water supply for new growth can come either from this source or by condemnation or first use of agricultural rights.

- Stream quality in the Front Range is degraded from municipal, industrial point source, and non-point source runoff from urban areas and agriculture. Reuse schemes must be viewed in the context of both instream water quality and quantity.

Section III identified four possible reuse systems. A subset of the recycling system would involve reuse of water by industry or for urban irrigation (e.g. golf courses). An evaluation of the environmental merits of four potential reuse systems is given in the list below. For comparison purposes, all four systems assume a doubling of population and water use in the region. All comparisons are from a base case of the present situation with limited reuse.

System No. 1: No Reuse --

- Increase in the environmental effects of West Slope diversions and/or condemnation of South Platte rights.
- AWT needed to meet standards or the total load of ammonia and nutrients to the streams will increase.
- Flow downstream will be augmented.
- TDS concentrations downstream decreased; total load increased.

System No. 2: Agricultural Successive Use --

- Increased effect of West Slope diversions and/or condemnation of South Platte rights.
- Stream quality below outfalls improved (TDS and nutrients decreased) during irrigation season.
- Ammonia nutrient benefits to agriculture.
- Smaller AWT plant may be required.
- Potential public health effects and soil damage.

System No. 3: Water Exchange - "First Use" by Municipalities --

- No additional effect on West Slope streams or from irrigation water rights condemnation.
- Stream flow between water supply diversion and wastewater treatment plants reduced.
- Nutrient benefits to agriculture.

- Offstream storage may be required.
- Higher TDS and lowered flow downstream.
- Potential public health effects and soil damage.

System No. 4: Increase by Recycling --

- No additional effect on West Slope streams or from irrigation water rights condemnation.
- Higher TDS in city drinking water.
- Possible other contaminates in drinking water.
- AWT plant for reuse and discharge required.
- Higher TDS and lowered flow downstream.

It is apparent in this analysis that no one system has an absolute advantage over another. Total costs have not been evaluated for such alternatives. There will be environmental benefits and impacts with any system.

System No. 1 has the advantage of providing more flow downstream to the agricultural community. In such a system, however, the owners of the imported water would have to receive compensation from potential downstream users for added water. West Slope streams would suffer the environmental impact of stream depletion.

System No. 2 has similar benefits and costs to System 1 except that stream quality in the vicinity of the municipality and immediate downstream would be somewhat improved.

System No. 3 has the advantage of no additional importation or condemnation of water rights. Nutrients are diverted from the stream in favor of farms. TDS values in the stream may increase, however, and stream flows within the vicinity of the municipality may be depleted.

System No. 4 involves no new or condemned water, but adds TDS and possibly other contaminates to the municipal drinking water. Alternatives to this are more expensive advanced wastewater treatments. Downstream flows would also be depleted and TDS would be increased.

Complications of real life situations can confuse this idealized analysis. In many cases, the depletions, nutrient removals and TDS incremental changes are small in comparison to the total water quality problem. Such systems may only marginally change water quality.

Exchanges can be complicated if some other higher use is made of canal waters (e.g. Barr Lake -- an irrigation storage reservoir contemplated as a recreation area).

West Slope diversions are generally not made on an incremental basis. Reuse schemes like 3 or 4 may be made in conjunction with large, capital-intensive West Slope diversions (e.g. Foothills and reuse projects of the Denver Water Board).

Protection of agricultural uses near the metropolitan area may not necessarily be safeguarded by "first use contracts". The decision to retain farmland in agricultural use near a metropolitan area is basically economically constrained. If the price of farmland conversion to urban uses is high enough, or if costs of operation (e.g. taxes and distance from marketing areas) of farms gets too high, farmland will still be converted. Given the same amount of water available for agricultural uses, new farms or expanded farms farther away from the metropolitan area may compensate for farmland lost around the metropolitan area.

Advanced waste treatment to remove ammonia, chlorine and phosphates is not now practiced in the Denver Metropolitan Area to meet the 1983 goals. A commitment to removal of these substances will be an expensive proposition. The value of any of the reuse schemes must be related to the most cost effective method of achieving these results. Although the State of Colorado has classified most Front Range streams as B-2 (warm water fishing, secondary contact recreation), funding has not heretofore been available for advanced waste treatment. Should the State determine that future funds will be used to remove ammonia, chlorine and possibly nutrients, reuse schemes could prove to be a cost-effective method of attaining water quality goals. However, adequacy of flows and stream habitat do limit the fishery potential in many streams in the Denver region. With certain reuse schemes which may improve water quality, stream flows may be further depleted. Therefore, both water quality and quantity must be considered in determining impacts of reuse on proposed stream uses.

Traffic

Impacts related to dependence on the automobile, such as low density or sprawl development, congestion and high noise levels in the central business district (CBD), will continue to worsen as the region grows. The situation of the commute-hour traffic overload on the region's highway system will continue and in some areas, such as the CBD and suburbs near the CBD, it will become worse. New highway construction to alleviate existing traffic problems will compound the situation by providing additional highway capacity which can accommodate more growth and its traffic. Further suburban growth would absorb the new capacity in a relatively short period of time. The Federal Urban Mass Transit Administration's denial of funds for a regional transit system eliminates the possibility of a fixed rail system for the present time. Any regional transit system proposed by the Regional Transit District (RTD) to compete with the automobile will have to rely on RTD's fleet of busses.

DIRECT ENVIRONMENTAL IMPACTS

Climate

Construction activities are generally restricted during Chinook events, which are temporary in nature and occur primarily in the winter when little heavy construction is done, thus minimizing effects upon construction. Wastewater treatment processes involving spraying, such as trickling filters and irrigation of effluent may produce local aerosols containing microorganisms and dissolved solids. During Chinooks, these aerosols could be carried long distances. Blowing particulate matter from spray operations and sludge disposal sites may impair vision and impede transportation. Some damages to physical property suffered during highwind occurrences would result in temporary, higher energy and cost requirements as repairs are made.

All land application methods, including percolation ponds, will affect the local microclimate. Volatilization of water molecules may lead to a local fog formation during certain cold temperature periods and produce a nuisance effect. Such an effect could take place at the proposed sludge land application site for Metro Denver, which is located close to the proposed Adams County general aviation airport causing costly delays in terms of time and manpower (Reference 126).

Low-temperature conditions can limit biological processes and thus curtail certain treatment processes such as aerobic digestion, trickling filter systems, and mechanical aeration.

The Littleton/Englewood, South Lakewood, South Adams, Aurora and MDSDD #1 plants have the highest potentials for odor problems on still days. The proposed satellite plant on Cherry Creek may have odor problems if future residential development occurs nearby.

Hydrology

The construction and operation of wastewater treatment plants can have important impacts related to the drainage network in the study area. Plant siting can affect the water supplies in downstream reaches by defining the point of return flow for the municipal water systems. Since both irrigation and municipal water systems use the drainage network for most of their supply, the point of return flow of domestic water can be critical. Plant construction and plant operation and maintenance will affect water quality in the drainage networks as discussed previously in "Water Quality".

Siting of those projects to be undertaken within floodplains requires special consideration. They must be designed so as not to increase the potential for flood damage either upstream or downstream. Since facility damage may result in direct release of untreated or partially treated sewage, the facilities must also be capable of withstanding the flood depths and stream flow velocities to be expected. Several interceptors such as Sand Creek, as well as the central plant expansion of MDSDD #1 and the lower South Platte and Cherry Creek satellite plants will be sited in floodplains.

Interceptors that will be aligned through wetlands/marshes, such as the proposed Sand Creek interceptor, may cause adverse effects. The trench excavation and the pumping to keep it dry during construction will lower the ground water table and may temporarily dry up the marsh. If gravel is used to backfill part of the trench, it could act as a drain to lower the ground water table permanently. On the other hand, any leakage of sewage from the interceptor might adversely affect the quality of the water in the marsh.

Geology

No significant direct alteration of land forms is anticipated through implementation of any of the alternatives. No significant direct impacts of geologic hazards, or on unique geological formations or structures are anticipated for any alternative.

Soils

Soil-related direct environmental impacts result almost exclusively from construction activities. These impacts consist of runoff erosion from construction sites and commensurate temporary surface water quality degradation. Wind erosion of exposed soils results in windborne dust and particulates. These effects are generally temporary. The local and no-action alternatives would cause the greatest number of erosion impacts and the regional alternative the least. No alternative would cause significant long term adverse impacts.

Biology

Direct Impacts of Local Alternative --

The identified alternatives would not significantly reduce flora or fauna in the Denver Metropolitan Area. In general, the treatment plant sites and the interceptor corridors do not support native plant communities. Rather, each of the sites proposed for wastewater treatment facilities is typified by introduced vegetation and wildlife species tolerant of human presence. All of the facilities are situated either in urban areas or areas traditionally supporting agriculture and grazing activities. Three types of potential impacts upon biotic communities have been identified. The first two relate to construction activities while the last one concerns facilities operations.

Disturbance or Loss of Vegetation and Wildlife Habitats -- New treatment plant facilities and interceptors would be constructed for the following service areas: South Adams, Englewood/Littleton Cherry Creek/Goldsmith Gulch, Lower South Platte, Clear Creek/Sand Creek, Northglenn and Broomfield/Westminster. Site construction would entail the removal of ground cover and reduction of habitat for some small animals. Principal plant cover in adjacent areas would remain relatively unaffected. No losses would be anticipated for highly productive habitat, or endangered or threatened plant or animal species. The main differentiation regarding impacts on vegetation and wildlife, which can be made between the various facilities plans, is related to the size of the facilities and subsequently the amount of flora and fauna that would be removed.

Disturbance of Aquatic Habitat During Construction -- Treatment plant construction adjacent to watercourses could cause short-term disturbances to the aquatic environment. Facility sites with potential effects on aquatic systems are Big Dry Creek, Lower South Platte and Clear Creek and Englewood/Littleton. Other facilities will probably use existing outfalls or convey effluents to a regional facility. Removal of riparian vegetation could increase erosion and adversely affect water quality and aquatic habitat. Increased turbidity and sedimentation will disrupt bottom habitat, kill invertebrates and degrade water quality. These effects on the aquatic environment would be a short-term adverse impact many hundreds of metres downstream of the facility. Physical stream conditions would be restored by the natural scouring and restoration effects of spring flows or seasonal upstream releases.

Effects Upon Aquatic Environment During Facilities Operations -- All of the proposed facilities would improve local water quality within the Denver area. The South Platte River would benefit from higher quality effluent discharged by the Englewood/Littleton, South Adams and MDSDD #1 facilities. Big Dry Creek would receive surplus flows from the Broomfield/Westminster facility.

This improvement in water quality would enhance productivity of the aquatic environment and, through the food chain, would also enhance productivity of the terrestrial environment. The resulting greater carrying capacity of these ecosystems could likely increase the number of individuals supported in the area. The potential for establishing species not presently supported in these reaches of Sand Creek, Clear Creek, Big Dry Creek and the South Platte River is likely to have both beneficial and detrimental ramifications. Overall, the multiple discharges provided in the local alternative offer the opportunity to increase habitat areas and promote a diversity of plant and animal species in the aquatic environment.

Direct Impacts of Regional Alternative --

The regional alternative, in general, would have fewer direct impacts than the local alternative due to the limited number of facilities. Potential impacts can be divided into the terrestrial environment of the facilities sites and the aquatic environment affected by the treatment facilities.

Disturbance or Loss of Vegetation and Wildlife Habitats -- Constuction of new facilities will be limited to the Englewood/Littleton, South Adams County and MDSDD #1 treatment plant sites and a new plant for the Brighton area. Interceptor routes that will be constructed through vegetated areas include portions of the lower South Platte drainage course. Other interceptor routes will follow established roadways. Impacts of biotic communities would be similar to those discussed under the local alternative.

Effects Upon Aquatic Environment -- The regional alternative consolidates all wastewater flows, except Englewood/Littleton, Brighton and Westminster/Bloomfield, to the Denver Northside and MDSDD #1 plants. With the abandonment of local treatment plants, stream areas will benefit from the termination of local discharges high in BOD, suspended solids, ammonia-nitrogen, chlorine and other pollutants. On the other hand, diversion of effluent discharges would reduce local stream flows by 0.09 to 0.44 cubic metres per second (2 to 10 million gallons per day). This would have a noticeable effect on smaller watercourses such as Sand Creek and Big Dry Creek, where diminished flows reduce the amount of aquatic habitat. In comparison with the local alternative, the greatest number of discharges (including reuse) would have the greatest benefit to the natural environment through enhancement of the water regime.

Direct Impacts of the No-Action Alternative --

The no-action alternative embodies the same facilities as the local alternative. Impacts relating to the disturbance or loss of vegetation and wildlife habitats and the disturbance of aquatic habitats during construction are similar to those discussed in the local alternative section. The main impacts of this alternative are the effects caused by delays in project implementation.

Effects Upon Aquatic Environment -- One to three year delays in project implementation will require the continued use of local treatment plants and discharges to local streams, but eventually the beneficial impacts will approach, but not equal those expected under the local alternative. The perpetuation of water quality problems presently experienced in some stream segments will be a short-term impact lasting an additional one to five years. Ammonia-nitrogen and chlorine residual, which in excess concentrations are toxic to aquatic life, are the parameters of significant concern to the South Platte River from the South Adams and Englewood/Littleton facilities, and to Sand Creek near the Aurora facility.

Energy

Estimates of the energy consumed in the construction of facilities described for each alternative are not available. However, a limited comparison between alternatives is possible. Three factors can be considered. These are the total length of installed interceptors, the number of plant expansions and/or upgradings in treatment levels, and the number of new plants constructed under each of the three alternatives during the next five years. Assuming one unit of energy per mile of interceptor, one unit per million gallons per day of plant expansion, and one-and-one half units per million gallons per day of new plant capacity, a comparison of construction energy demands indicates that the local and regional alternatives are essentially the same. Because the no-action alternative includes delays in construction beyond the five-year period considered in this comparison, not all the reduction in energy demand would be realized.

Energy use during operation of the facilities will be dominated by the wastewater treatment plants themselves. First order estimates of the increase in natural gas and electrical power yearly demands of the alternatives five years hence are:

	Local	Regional	No-Action
Natural gas, million cubic feet	40	30	8
Electric power, million kilowatt-hours	11	9	3

In this instance, the local alternative will result in the highest increase in energy demand. The significant quantities of natural gas that would be demanded for the local and regional alternatives are of particular concern as shortfalls in natural gas supplies for the Denver region are expected as early as the 1978-79 heating season. As wastewater treatment plants should be considered as interruptable consumers of natural gas, loss of process heat is a real possibility. Plant effectiveness would be degraded with consequent deterioration of effluent quality during stream low-flow periods. Stream or receiving water's water quality could therefore be significantly affected.

Transportation

Direct impacts are construction-related and thus of a temporary nature. These impacts relate to disruptions of traffic flow near construction sites, and are likely to be greatest for the local alternative, somewhat less for the no-action alternative, and least for the regional alternative. No significant adverse impacts are anticipated.

Historical Features

Although no individual wastewater treatment plant would cause the removal or destruction of a designated historical landmark, some of the sites are near designated landmarks or in historical areas. The South Platte River Valley, downtown Denver and Cherry Creek vicinity are areas of great historical interest; new interceptor lines will pass through these areas and the other creek basins as well under the regional alternative. Although historic sites having potential for official recognition, as well as currently designated ones, are not directly threatened by construction activities, they could be damaged structurally by such construction techniques as blasting and trenching. Hauling of construction material past historically significant points during the construction phase of one to two years duration could cause accumulative vibrational effects, but only in a very localized corridor along construction routes. Vibrational effects of hauling are of much smaller effect than actual pipeline excavation. Depending on the depth to bedrock or impervious layer and other factors, carving or blasting may be required along limited segments of the interceptor routes. Facility planning in the current planning stage has not determined the exact alignments. As excavation impacts are generally localized within approximately 3 metres (ten feet) on each side of the trench, it would not be appropriate, and perhaps misleading, to project impacts over large areas until such information becomes available. The effects of dust and dirt raised by construction activities upon historic sites would also be minimal and difficult to predict at this time.

Outdoor Recreation Sites

Very few current recreation sites will be directly affected by construction of the proposed wastewater treatment facilities under any alternative, as few new plants are planned. More new facilities are incorporated in the local alternative than in the regional alternative, thus potential impacts of the local alternative are greater. Water-based recreation plays a major role in Denver. Many recreation sites are located adjacent to or surround streams, lakes and reservoirs. As wastewater treatment facilities are to be located at points along these streams and several interceptor routes have been planned to lie adjacent to stream beds, some conflicts in siting may arise. The Bureau of Outdoor Recreation (BOR) has identified some possible areas of conflict along Sand Creek, Clear Creek and the lower South Platte drainages, and has recommended that multiple use of land be a planning goal. A recreation plan is being developed for the Sand Creek-Tollgate Stream corridor as a segment of the Corps of Engineers' Denver Metro Study. The proposed interceptor right of way would be a good location for hiker-biker trails to connect with those of the South Platte River Greenway. The proposed Clear Creek treatment plant location could be a potential recreation site. Either alternative could incorporate a trail system similar to that of Sand Creek. For the lower South Platte, the BOR has identified in the Denver Metro Study that a new wastewater treatment plant at 164th Avenue may conflict with a potential recreation site (Reference 126).

Stream flow may be augmented through treated discharge at many points in the local, new plants alternative, rather than at a few plants in the regional and no-action alternatives. The BOR has identified four areas of recreational benefit and potential resulting from new plant operation:

- Return of a steady water flow to Sand Creek, which could increase recreation benefits for hiking, bicycling and nature study. This flow would not occur under the regional alternative.

- Return of water flow to the proposed Corps of Engineers reservoir to help maintain a conservation pool.

- The use of additional open space area for certain kinds of recreation around the plant site.

- Underground construction of certain components of the plant and utilization of the surface area for park and recreation purposes.

In addition, discharges of a relatively higher quality water than the current stream flow will enhance fishery potential in areas not radically modified by channel improvements (see Map F), providing that flows are high enough and water quality is sufficient to sustain a fishery. Increased flows will also enhance other recreational activities such as boating and general stream aesthetics, thus serving to enhance the quality of recreation experience obtainable at downstream sites. The more specific impacts on water quality and flow augmentation are addressed in the "Water Quality" section.

Two factors considered in the biological direct impact section have effects upon outdoor recreation: (1) the disturbance or loss of vegetation and wildlife habitats; and (2) the disturbance of the aquatic environment. In the local and no-action alternatives, four and one new treatment plants respectively and six and four plant expansions respectively will permanently remove ground cover and reduce small animal habitats, thereby reducing potential recreational opportunities in these areas. Although water quality will be enhanced by the addition of high quality effluent, the construction disturbances, such as erosion of banks and siltation of streams, may extend many hundreds of metres downstream and last one to two years, thus impairing downstream recreational experiences. Those alternatives with the greatest number of discharges, including reuse, would have the greatest benefit to the natural environment and recreational experiences through enhancement of the water regime.

Land Waste Treatment

None of the proposed alternatives contemplate land percolation or infiltration as a wastewater treatment method. However, significant reuse is planned where effluent would be used for urban or agricultural irrigation, either directly or through exchange agreements. Another motive for reuse, particularly through exchange agreements, is to secure additional water supplies for domestic or industrial use. Irrigation reuse is also attractive, as discharges to streams are reduced with usually beneficial effects on stream water quality, and nutrients and organic material are beneficially recycled into the ecosystem.

Crop irrigation with wastewater effluent of the quality expected from proposed facilities is generally restricted in the United States, although it is more common in Europe. Use for irrigation of crops for direct human consumption is generally prohibited. The reasons are based on unknown risks of contamination by pathogens (bacteria and virus), mutagens and carcinogens. Other concerns are buildup of salts in soils reducing productivity, buildup of heavy metals and chlorinated hydrocarbons in soils, and subsequent uptake by plants and eventual contamination of ground waters. Thus reuse for agricultural irrigation presents both risks and benefits.

Aesthetics

Direct impacts on the visual and aesthetic environment can be divided into construction effects lasting only a short-term and operation effects which entail both short- and long-term impacts. Similar types of effects occur within the local, regional and no-action alternatives. Differentiation between alternatives basically relates to the amount of area disturbed by the individual facility sites.

Construction Effects --

Adverse effects on local aesthetics during construction are generally related to nuisance factors. Pipeline excavation and treatment plant site preparation entail earth-moving, grading, and in some cases, dewatering. Depending upon seasonal and topographic conditions, the generation of suspended particulate matter is unavoidable. Construction noise, engine emissions from heavy equipment and vibrations are other nuisance effects. Traffic rerouting, temporary stockpiling of materials along roads, and increased truck traffic during construction periods constitute temporary inconveniences which will require residents to make short-term adjustments.

Operation Effects --

The local alternative with multiple treatment facilities would tend to have greater odor, noise and visual impacts than the regional alternative. The construction and operation of a treatment plant would certainly be intrusive and would tend to alter the character of the surrounding area. The structural facilities can be located away from areas of high visibility and designed to be visually and aesthetically compatible with the environs. However, plant operations will entail equipment noise, processing odors, incidental lighting and traffic from maintenance vehicles to some degree. Facility sites creating the greatest disturbance would be those closest to residential or commercial developments. Thus, expansion of the Aurora plant, the proposed Clear Creek plant, and the South Lakewood plant may cause some conflicts.

Facility plans which incorporate some system of treatment or disposal by land application would be more land-intensive than structural treatment systems. Land application probably would not be noticeable as a distinct and separate land use within an agricultural community. However, potential odor problems during adverse conditions may affect a larger area than that of a small physical plant.

In an overall evaluation, the improvement of wastewater treatment in the planning area strives toward obtaining and enriching cultural goals such as recreation, ecological viability and aesthetic enjoyment. These are presently fulfilled in the mountain parks and streams west of Denver. For the plains streams, however, improvement in water quality alone will not fulfill those goals. Hendricks and Bluestein (Reference 982), in their study of the South Platte River concluded that:

"Their achievement is essentially precluded by the modifications brought about by intense human uses of the stream and associated lands and by the natural characteristics of the plains streams. Thus, improvement of water quality in the plains South Platte to 1983 levels (as specified by PL 92-500) will result in few benefits and at very high costs. However, to permit deterioration of the mountainous South Platte will result in irrevocable societal losses. From all of this, it would seem that the most cost effective investment policy would be to protect the mountainous South Platte from deterioration and to maintain the plains South Platte to permit continuance of existing human activities".

V. Comments and Responses

SECTION V

PUBLIC COMMENTS

Written comments on the Draft EIS were received from federal, state, regional and local agencies, and from special interest groups and private citizens. The review of these comments disclosed that most of them fell into two groups. One group consisted of technical comments concerned with errors, corrections, or clarifications of technical information. The other group of comments addressed substantive issues which had been raised in the Draft EIS or during public review and discussion. EPA has decided that the most effective way to deal with this latter group of comments is by a consolidated response, incorporating a discussion of each issue and the actions, if any, EPA will take. These issue discussions and EPA actions are presented in Volume 1, Sections III and IV.

Of the remaining comments, a number were of a nature which requires no response, while the rest addressed the scope of the EIS and the detail to which various environmental aspects were addressed. Some comments were received which took the position that the Draft EIS was too broad in scope, and reached too far in including growth related impacts as a consequence of EPA funding of wastewater treatment facilities. EPA does not maintain that all or part of the growth related impacts are due solely to EPA's funding of wastewater facilities. EPA does maintain that its role in funding wastewater facilities which accommodate future growth means it must share some of the responsibility for the environmental consequences of that growth. One of the more immediate concerns to EPA is that the obligation of its available funds under the Clean Water Act is not in conflict with EPA's responsibilities under the Clean Air Act. Other comments received commended EPA for the breadth of the scope of the EIS, but expressed a desire for more detail. These comments generally took the position that the scope of the EIS was necessary and appropriate and represented a valuable first step toward dealing with a federal agency's role in regional environmental issues. The question of detail is always difficult to deal with in an EIS of this scope. Much additional information has been developed since the Draft EIS was sent out for public review, and has been incorporated into this Final EIS particularly as it relates to EPA's actions and policies adopted as a consequence of this EIS.

The EIS explores in varying degree the impacts of growth on the demand for public services. The depth to which an impact on a public service is explored is related to the degree of responsibility, authority, and direct or indirect EPA involvement. For example, sewer service and wastewater treatment is a public service explored in detail, while schools are briefly addressed.

Both the U.S. Department of Housing and Urban Development and the Governor of State of Colorado commented on this uneven treatment of public service impacts.

The original impetus for this regional EIS was to provide a mechanism for addressing region-wide secondary impacts which were very difficult to address in individual project EIS's, and to respond to citizen and other agency calls for an overview environmental assessment which would assist in assessing proposed EPA, HUD and BLM projects affecting the Denver region as well as other subsequent federal actions. EPA and HUD together explored and promoted the concept of a joint EPA-HUD-BLM assessment effort, but procedural, planning, and budget difficulties could not be surmounted. Consequently, EPA initiated its regional EIS which would stress areas of primary EPA concern, and at the same time coordinate with and recognize the work BLM was engaged in on the Foothills EIS and HUD's work on its "areawide" EIS. This was done with the expectation that the BLM and HUD EIS's would explore certain categories of impacts in greater detail.

The EPA has no extant options regarding this issue as current federal policies mandate cooperation between agencies of the federal government. The EPA has reviewed the "Environmental Statement - Proposed Foothills Project" by BLM and the "Denver Metropolitan Region Environmental Assessment" by the Denver Regional Council of Governments for HUD, and although not necessarily agreeing with all the findings of those documents, finds they contain relevant environmental information, and hereby incorporates them by reference into the "Denver Regional EIS for Wastewater Facilities and the Clean Water Program." This additional information has been used and considered by EPA in formulating its decisions and policies.

All written comments that were received are included in this Section, and EPA's responses, where appropriate, are given immediately following each comment letter. Public input received as a result of the newspaper supplement and meeting brochures has been consolidated and analyzed in the publication "Attitudes of Denver Region Residents on Environmental Issues." See Reference 130, which is available at EPA's regional office at 1860 Lincoln, Denver, Colorado.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
11177 West 8th Avenue
P.O. Box 25127
Lakewood, Colorado 80225

July 11, 1977

8400

Mr. John A. Green
Regional Administrator, Region VIII
Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80202

Dear Mr. Green:

Following are our comments on the "Denver Regional Environmental Impact Statement for Wastewater Facilities and the Clean Water Program."

1. The title of the ES should be changed to be more closely related to the subject matter which is more an assessment of environmental effects resulting from further growth of the Denver metropolitan area than a study of wastewater treatment alternatives. As an example, on page VI-2 (8) a shortage of natural gas by 1978-1979 is listed as an unavoidable adverse impact. Obviously, this is not related to the environmental effects of the wastewater treatment alternatives. ①

2. Minor changes which we believe would improve the statement include:

   (a) p. II-32-there is no cold-water fishery in Big Dry Creek above Standley Reservoir; ②

   (b) p. II-43-"rare and endangered" is obsolete terminology. Should be "endangered and threatened;" ③

   (c) p. II-44-there are no black-tailed deer - must be either white-tailed or mule deer; ④

   (d) p. II-44-otter records in Weld County date back to 1906. This record could hardly describe the existing environment. ⑤

SHanks
S. H. HANKS
Deputy Regional Forester, Resources

RESPONSES TO COMMENTS BY
U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
11 July 1977

1. Please see the introduction to Section V, Volume 2.
2. Table II-F of Section 2, Volume 2, has been amended to note this comment (p. 43).
3. All references to "rare and endangered" species in the draft EIS have been changed to "endangered and threatened" species in the final EIS.
4. All previous references to "black-tailed deer" have been changed to white-tailed and mule deer in Volume 2 (p.57).
5. Additional information regarding the presence of otters in the region has been added in Section II, Volume 2 (p. 57).

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

P. O. Box 17107, Denver, Colorado 80217

July 8, 1977

Mr. John A. Green
Regional Administrator
U. S. Environmental Protection Agency
1860 Lincoln St.
Denver, Colorado 80203

Dear Mr. Green:

Thank you for sending us a draft copy of the Denver Regional Environmental Impact Statement for Wastewater Facilities and the Clean Water Program. We have the following comments to offer:

Page II-64 - We believe a further distinction should be made between prime lands as defined by the Soil Conservation Service versus the prime agriculture soils as identified by the Denver Regional Council of Governments (DRCOG). The DRCOG used our criteria in identifying prime lands; however, they went beyond our definition and included additional lands of regional importance (map D). We do not object to this; however, we suggest that the report acknowledge this difference or explain that a combination of map D (prime agriculture soils) and map H (land use) will identify the prime lands as defined by SCS, since only the irrigated soils in Colorado that fit our criteria can be considered prime lands. The difference in acreage between the two categories of prime lands is significant; consequently, the degree of impacts related to urbanization would also be significant. ①

Page IV-32 - Causes of Agriculture Land Consversion

We would like to suggest a couple of additional reasons why farmers continue farming. ②

Increased land values have enabled some farmers to borrow money against increased equity in their land which allows them to continue operating.

In addition, farmers are not always motivated by economic reasons when deciding what to do with their lands. They continue farming because they enjoy living and working on the land, even though they may suffer financially.

Page V-21 - Water Erosion

We are developing an erosion control guide for urban areas which will be helpful to planners and developers in controlling erosion for construction related activities. ③

Thank you for the opportunity to review and comment on this proposal. We compliment you on your discussion of prime lands and related impacts. If you have any questions concerning prime lands, please contact us.

Sincerely,

Robert G. Halstead
State Conservationist

cc: R. M. Davis, Administrator, SCS, Washington, D.C.
Office of the Coordinator of Environmental Quality Activities
Office of the Secretary, USDA, Washington, D.C.
Council on Environmental Quality (5 copies)

RESPONSES TO COMMENTS BY
U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE
8 July 1977

1. Please see discussion on prime agricultural soils and lands in Volume II, page 72.

2. This comment has been added to the test of "Causes of Agriculture Land Conversion," Section IV, Volume 2 (pp. 140 and 142).

3. No response required.

United States Department of the Interior
OFFICE OF THE SECRETARY
MISSOURI BASIN REGION

BUILDING 67, DENVER FEDERAL CENTER
DENVER, COLORADO 80225

IN REPLY REFER TO:
ER 77/564

August 1, 1977

Mr. John A. Green
Regional Administrator
Environmental Protection Agency
Region VIII
1860 Lincoln Street, Suite 900
Denver, Colorado 80203

Dear Mr. Green:

Personnel of the Department of the Interior reviewed your Draft Environmental Statement for the Denver Regional Wastewater Facilities and Clean Water Program and have the following comments to offer.

General

1. The environmental statement should identify a recommended plan and evaluate the associated environmental impacts with and without this plan. Furthermore, the alternatives to the recommended plan and the resulting impacts should also be identified. ①

2. The EPA has explained the factors that induced it to include so much information concerning the impact on air quality of wastewater treatment-aided growth in the Denver region. Nevertheless, the amount of material on air quality standards, forecasts, and potential abatement strategies seems disproportionately large. As a result, overall document focus and intelligibility seem to have suffered. ②

3. The final EIS should indicate continuing consultation with the State Historic Preservation Officer and his professional staff, consistent with the letter and spirit of the National Historic Preservation Act of 1966, the National Environmental Policy Act of 1969, and Executive Order 11593. Moreover, the final environmental impact statement should further reflect procedures to be followed should previously unknown archeological resources be encountered during project development. In short, all actions taken to guide project development should be in compliance with the Advisory Council on Historic Preservation "Procedures for the Protection of Historic and Cultural Properties" (36 CFR, Part 800). ③

We further suggest that in order to protect any archeological sites identified that specific site location information not be included in the final environmental statement. However, this document should include a copy of all project related correspondence to facilitate and expedite the review process.

4. The draft environmental statement thoroughly analyzes the water quality needs of the Denver Metropolitan Area and the alternative of regional versus local treatment of wastewater. However, the statement does not "develop a preliminary design for the project" as was intended under "Step I" of the water quality planning process described on page 2 of the Summary. Without this preliminary design and its concomitant site-specific description of proposed facilities, we cannot determine the impact of the project on local outdoor recreation resources. More detailed information on the location of any proposed waste treatment facilities and an analysis of their environmental impacts is needed, either by means of a more specific final statement or a separate environmental statement for each facility. ④

5. The EPA should be aware that there are numerous recreation areas within the study region which have received matching assistance monies from the Land and Water Conservation Fund (L&WCF). Encroachments on properties that have received L&WCF assistance would constitute a conversion of recreation use under Section 6(f) of the Land and Water Conservation Fund Act, as amended. Section 6(f) requires that any change from recreational land use be approved by the Secretary of the Interior and also requires the substitution of other properties of at least equal fair market value and reasonably equivalent usefulness and location for the recreation lands to be taken. There is no provision under this section for acceptance of cash in payment for recreation lands converted to other uses. ④

6. There are also several properties within the study area which have been transferred from Federal ownership to local agencies for park and recreation purposes. Conveyance has been accomplished under the provisions of the Surplus Property Act of 1944 (58 Stat. 770), as amended, and the Federal Property and Administrative Services Act of 1949 (63 Stat. 377), as amended. The provisions of the Instrument of Transfer specify that the property shall not be sold, leased, or otherwise disposed of except with the consent of the Secretary of the Interior. Substitution of properties of at least equal fair market value and reasonably equivalent usefulness and location for the recreational lands to be taken would be required. ④

7. Any temporary or permanent disruption of recreation resources, including those having received Federal assistance, and appropriate mitigation, should be addressed in the final environmental statement. In addition, we suggest that direct, positive recreational benefits ④

could be incorporated into the project. It would be possible, for example, to qualify for L&WCF monies for acquisition and/or development of lands adjacent to proposed construction sites which could serve both as buffers and as recreational resources in their own right. Another possibility would be to incorporate bikeways or trails on the rights-of-way of sewer trunk line construction. These factors should be discussed in the final document.

Specific Comments

1. In the Summary Sheets under Item 3, Environmental Impacts, most ⑤
of these items should be grouped under "growth induced environmental
impacts." These are Nos. 1, 2, 3, 5, 6, 8, 9, 10, 12, 13, 14, 15, 16,
17, 18, 19, 20, 21, 22, 23, 24. The remainder of impacts identified
should be attributed to the construction of the wastewater facilities
and the implementation of the clean water plan. The document describes ⑥
the multitude of impacts associated with the growth of the Denver
Metropolitan Area and does not identify the specific impacts which
would result by the implementation of the clean water plan or
construction of wastewater facilities.

2. On page I-12 there is reference to other environmental impact statements which are in process and about to be released. This is misleading and gives the reader the impression that other EIS's must be reviewed in order to get the total picture about the conditions associated with this Federal action. ⑦

3. On page II-39, it is stated that the Coal Creek was degraded in 1972 by, among other things, "the extraction of coals." This should be modified to indicate that the degradation arose (as indicated on page A-31) from the former mining of coal. According to all records, no coal has been mined in the Coal Creek drainage for many years. ⑧

4. Table headings are missing on Table IV-A. Irrigated land ⑨
descriptions shown on map H does not appear consistent with the
amount of irrigated land shown in tabulations II-Q and II-P. This ⑩
omission and inconsistency should be clarified in the final EIS.

5. One finding of the Corps of Engineers' Denver Metro Study mentioned on page IV-93, is that the South Platte River has potential for further development as an urban riverway. The construction of additional waste treatment facilities in the South Platte River flood plain may jeopardize this proposal and conflict with proposed park areas in the vicinity of the river. We recommend that the final document provide information concerning the approximate location of proposed facilities and fully evaluate the relationship of these facilities to the urban riverway concept. ④

6. It should also be noted that while park vandalism and misuse in the Denver area (page A-58, Appendix, et al.) have been problems in the past and will undoubtedly continue to be problems in the future, it is our conclusion that they are neither most significant nor unique to the area. The Corps' Metro Study, for instance, determined that the lack of funds for operation and maintenance of existing park areas was the most pressing recreational problem. The potential overuse of these resources (page 19, Summary) due to increasing population pressures will probably require as a solution acquisition of more areas or limiting of use of the existing areas. ⑪

7. In addition, we suggest that the final document reference the source of the many recreation statistics presented in the draft statement since it is unclear what guidelines were used to compile them. Park density figures, for example, are dependent on a combination of many variables--political or social boundaries, population projections, type of park acreage, standards used, etc. (we presume that park density acres per capita, page 13 of the Summary, et al., was meant to be acres per 1,000 population). Two ongoing recreation studies of the Denver area, the Corps of Engineers' Metro Study and the Bureau of Outdoor Recreation/National Park Service Urban Study, may be helpful sources of additional recreation data. The Bureau of Outdoor Recreation, Mid-Continent Region, P.O. Box 25387, Denver Federal Center, Denver, Colorado 80225, would be pleased to furnish copies of these studied when published or, upon request, offer any other assistance and information. ⑫

8. The statement asserts that strata of the Denver Basin dip slightly toward the east (page A-7). However, the Denver Basin is a structural as well as a physiographic or topographic feature. The configuration of some of the basin up through the Fox Hills-Laramie Formations and at least the basal beds of the intertongued Arapahoe and Dawson Formations dip toward the axis of the basin. Dips are generally very steeply eastward at outcrops on the west side of the basin, but more gently northward in the southern portion of the basin and westward on the east side (Finley, E. A., Dobbin, C. E., and Richardson, E. E., 1955, Preliminary structure contour map of the Colorado Plains: U.S. Geological Survey Oil and Gas Investigations Map OM 176). As would be expected from the configuration of the basin mentioned above, some recharge to the deeper aquifers also occurs in the eastern and southern portions of the basin (page II-24, paragraph 2). ⑪

9. One reiterated statement of some concern is a projection of future conflict in the Denver region between demands for water by the electric power industry and agriculture. These include: ⑬

a. Pages 17-18 (of Draft Summary). "After 1980, if the scheduled development of power plants are delayed significantly, some brown-outs or load reduction will occur. The increased demand for electrical power will probably be met with coal-fired power plants which will necessarily increase Colorado's coal production. Consequently, beginning in the 1980's conflicts may arise between municipal and agricultural water users in the Denver region, and energy industries over available water supplies." ⑬

b. Page II-44. "Projected shortfalls in supplies of natural gas will pose a constraint on growth after 1980. In the long term, increased reliance on coal-based electrical generation will force increased competition for available supplies of water which are necessary for coal mining and processing and air pollution abatement." ⑬

c. Page IV-81. "The increased demand for electrical power will probably be met with coal-fired power plants which will necessarily increase Colorado's coal production. Consequently, beginning in the 1980's, conflicts will arise between municipal and agricultural water users in the Denver region, and energy industries over available water supplies." ⑬

d. Page VI-2. "9. Increased dependence on coal for electrical power generation will create new water allocation and quality problems." ⑬

Although not always specifically stated, all of the above statements apparently refer to: (1) the Denver region as defined for the study, and (2) the 1980's. According to the best available information, no new powerplants or powerplant expansions, coal-fired or fueled otherwise, are planned for the Denver region for the next 10 years. Given the long lead times involved in planning and constructing coal-based powerplants, it is rather unlikely any new facilities would be built until at least the 1990's. Moreover, it seems unlikely that any power facility with even a slight air pollution potential, such as a coal-fired powerplant, will be built in the Denver region during the present century. We believe the above statements should be modified to indicate there is only a slight possibility of conflict over water supplies between coal-based electric power generating facilities and agriculture and other users within the Denver region within the time span of the study.

10. We also wish to call attention to the assertion in the above statements that increases in Colorado coal production would "necessarily" ⑭ result from an increase in coal-based powerplants serving the Denver region. Between 1977 and 1985 the Public Service Company of Colorado plans to build or participate in building coal-based generators in Fort Morgan, Southeastern Colorado, and Craig. Although the Craig plant is scheduled to burn Colorado coal, Wyoming coal is to be used in the other generating facilities.

11. In addition to a strong possibility that as yet unidentified, archeological sites are located in the project area, Appendix A, pages 59-67, and Appendix B, page 8, both establish the presence of many historical sites in the Denver area. The final environmental impact statement should establish which cultural resource sites are located in the project development area, which of them are on the National Register of Historic Places, and which cultural resource sites are believed to be eligible for such listing. If any of these sites will be affected, the final environmental impact statement should state in what manner, and how any adverse effects noted will be mitigated. ⑮

Thank you for the opportunity to review and comment on your draft environmental statement and project. We hope these comments will be helpful in your preparation of the final statement.

Sincerely yours,

John E. Raybourn
JOHN E. RAYBOURN
Regional Environmental Officer

RESPONSES TO COMMENTS BY
U.S. DEPARTMENT OF THE INTERIOR
1 August 1977

1. Please see discussion in Section III, Volume 2 and the Introduction to Section V, Volume 2. EPA's proposed action are continued in Volume I.

2. Please see discussions in Volume 1, subsections III-1 and IV-1, and the Introduction to Section V, Volume 2.

3 Please see Volume I, subsection IV-9.

4. Please see discussions in Volume 1, subsections III-10 and IV-10.

5. The Summary has been revised, see Volume 1.

6. Please see discussions in Volume 1.

7. Section I of Volume 2 has been amended to prevent any misleading impressions regarding a reader's need to review other EIS's (p. 12).

8. The word "former" has been added, as recommended, to Section II, Volume 2 (p. 52).

9. Column headings have been added to Table IV-A (p. 109).

10. The irrigated land shown on map H is that that has been mapped by the U.S. Geological Survey. The sources for other data used in the text to delineate agricultural land areas are mentioned, see page 72, Volume 2.

11. No response required.

12. The recreational statistics cited in the EIS are from present and future estimates of land uses made by DRCOG.

13. Recognizing that Denver competes for western slope water, the text of the final EIS (Volume 2) has been changed according to your comments.

FEDERAL ENERGY ADMINISTRATION
REGION VIII
1075 South Yukon
P.O. Box 26247, Belmar Branch
Lakewood, Colorado 80226

June 27, 1977

Mr. John A. Green
Regional Administrator
Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Dear Jack:

We have reviewed the draft environmental impact statement on the Denver Regional Wastewater Facilities and the Clean Water Program and feel this regional draft is adequate as written. It details the general environmental considerations of the greater Denver Metro area quite well.

We assume the site specific wastewater treatment facilities in the metropolitan area being funded under the 201 program will now only need brief environmental analyses, eliminating the need for draft and final EIS's as a result of this regional EIS. Is this reasoning correct? ①

Thank you for the opportunity to comment on this draft EIS.

Sincerely,

Dudley

Dudley E. Faver
Regional Administrator

RESPONSE TO COMMENT BY
FEDERAL ENERGY ADMINISTRATION
27 JUNE 1977

1. It is expected that this EIS will eliminate the need for further, lengthy environmental review for the projects being considered.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGION VIII
FEDERAL OFFICE BUILDING
19TH AND STOUT STREETS
DENVER, COLORADO 80294

July 14, 1977

OFFICE OF THE REGIONAL DIRECTOR

Mr. John A. Green
Regional Administrator
U.S. Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Dear John:

Thank you for the opportunity to review the draft environmental impact statement for the Denver Regional Wastewater Facilities and Clean Water Program.

It appears that the impacts expected to result from this proposed project and reasonable alternatives thereto have been adequately addressed. ①

Sincerely yours,

Edwin R. LaPedis
Acting Regional Director

cc:
Office of Environmental Affairs
HEW, Washington, D.C.

Council of Environmental Quality
Washington, D.C. (2 copies)

RESPONSES TO COMMENTS BY
U.S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE, REGION VIII
14 JULY 1977

1. No response required.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGIONAL OFFICE
EXECUTIVE TOWER - 1405 CURTIS STREET
DENVER, COLORADO 80202

REGION VIII

July 18, 1977

IN REPLY REFER TO:
8DE

Mr. John A. Green
Regional Administrator
Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Dear Mr. Green:

This is in response to the Environmental Protection Agency (EPA) Draft Denver Regional Environmental Impact Statement (EIS) for Waste Water Facilities and the Clean Water Program dated June 1977.

We agree with the statement in your Draft Summary EIS that the provision of waste water facilities to accommodate future growth must be considered a contributing factor to the environmental consequences of that growth. We appreciate the fact that EPA must decide what role, if any, it should play in supporting future growth along with the related environmental effects. It is this understanding that forms the basis of our following comments: ①

1. The Draft EIS discusses in great detail the problem that agricultural land is being converted to urban use. The statement points out that the Council on Environmental Quality (CEQ) has recognized this problem and has required special consideration by Federal agencies whose actions affect the conversion of "prime" or "unique" farmland to other uses. We feel that the Draft EIS misrepresents the impact of converting "prime" farmland to other uses in both Table IV-L and Map D, Prime Agricultural Soils. The responsibility to define "prime" and "unique" farmland has been given to the Department of Agriculture, Soil Conservation Service (SCS). According to the SCS definition of "prime" farmland, the land must be capable of producing a viable crop seven (7) out of ten (10) years. In the Denver area, such production can only be obtained from irrigated lands. The areas delineated on Map D are properly labeled as "Prime Agricultural Soils." ①

Many of these areas do not meet the SCS definition of "prime" farmland because they are not irrigated and lack sufficient moisture to produce at the required rate. We suspect that the data that appears in Table IV-L was obtained from Map D and therefore, would misrepresent the impact on "prime" farmland. We also feel that this data was used in the narrative portion of the Draft EIS and may represent an inaccurate conclusion. We feel that a map properly delineating "prime" farmland should be included in your Final EIS. Such a map with supporting data has been prepared for use in HUD's forthcoming environmental assessment of this area and is available for your use if requested. You will find that this new information will indicate an uneven distribution of "prime" farmlands within your Waste Water Facilities Planning Areas. As you indicated in your Draft EIS, page IV-30, "Growth will go where facilities are available to serve it,..." It would seem appropriate for you to determine the amount of "prime" farmland that would be converted to urban use within each service area and then take this adverse impact into account in your decision on each of your waste water facilities. We feel that such a discussion should be included in the Final EIS. ①

2. You have indicated in your Draft EIS that the forecasted growth will cause an increased demand on community services and facilities; however, it does not appear that equal consideration was given to all services and facilities. For example, individual assessments are included for transportation and recreation, but not for such services and facilities as public safety (fire and police), schools, solid waste, etc. It has been our experience that schools are consistently impacted by growth, and that over crowding occurs in certain parts of the Denver area. We feel that the Final EIS should discuss these impacts equally and that the impacts should be quantified by your Waste Water Facilities Planning Areas. This would enable EPA to weigh these impacts in deciding on the best course of action for each waste water facility. ②

3. We question the discussion on Outdoor Recreation Sites in several areas. On page IV-82, you indicate that land areas for parks will decrease "from 15.2 acres per capita in 1970 to 9.9 acres per capita in 2000." We assume the unit of measure was intended to be acres per 1,000 population instead of per capita. The Draft EIS does not indicate the statistical basis for this statement which is in conflict with another statement on page V-25 which implies that municipalities have kept pace in developing parks as populations have increased and that such a trend will continue. Also ③ on page V-25 you suggest that local governments require that developers provide neighborhood recreation facilities as a part of their development proposals. We assume you mean that developers should pay for the development of such facilities since under the current practice, developers do donate land for recreational use. Your suggestion would be an "ideal" solution; however, could not be implemented, as would be the provision of classrooms, solid waste disposal facilities, sewage treatment plants and other service facilities. Your suggestion is very theoretical and proposes attractive but not realistic solutions. A similar theoretical solution could be proposed for the Denver air quality problem in that governmental controls should dictate that only non-polluting vehicles be permitted in the Denver area. This also illustrates an "ideal" but impossible solution to a problem. If there are no solutions that can be implemented to correct this impact, then that should be stated in the Final EIS and taken into account in your decision-making process.

As you mentioned in your Draft EIS, HUD is preparing an environmental analysis ④ of the impacts of growth in the Denver Metropolitan Area. This analysis should be complete by September of this year and should be published as an EIS this winter. We would be happy to provide you with any portion of our assessment that might aid you in your decision-making process as soon as it is available.

In addition to our comments on your Draft EIS, we are enclosing the comments of our Headquarters office in the form of a memorandum from James F. Miller dated July 8, 1977.

Thank you for the opportunity to provide these comments.

Sincerely,

Robert J. Matuschek

Robert J. Matuschek
Assistant Regional Administrator
Community Planning and Development

Enclosure

RESPONSES TO COMMENTS BY
U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
18 July 1977

1. Please see discussion on prime agricultural soils and lands in Volume II, starting on page 72 and in Volume I, subsection III-9 and IV-9.

2. Please see the Introduction to Section V, Volume 2.

3. The correction suggested to page IV-82 of the draft EIS has been made in Volume 2, page 194. Regarding the issue of developing new parks, we believe that a developer should be required, at a minimum, to provide land for parks, where needed. In many areas land, as well as more elaborate provisions for parks, recreation, and open space are met by developers and therefore, it does not appear to be an "ideal but impossible solution."

4. The assessment report as provided by DRCOG to HUD was reviewed and utilized in finalizing this EIS.

HUD-96 (7-75) PREVIOUS EDITION MAY BE USED

Memorandum

U.S. DEPARTMENT OF
HOUSING AND URBAN DEVELOPMENT

TO : Walter Kelm, Director, Environmental
Quality Division, Region VIII

DATE: JUL 8 1977

IN REPLY REFER TO:
CSP

FROM : James F. Miller, Environmental Planning Division, CSP

SUBJECT: EPA Regional Environmental Impact Statement for Wastewater Facilities and the Clean Air Program

This is in response to the memorandum to Richard H. Broun on this
subject. Our major comment is that the EIS really does not address
the issue of alternative urban growth patterns and their implication, ①
in terms of various environmental factors, that could result
from alternative wastewater treatment and air pollution control
strategies.

Impact analysis is based on the present growth trend, continued ②
urban sprawl and the decline of the City of Denver. It considers
physical impacts under this assumption, with some exceptions
(biologically sensitive areas affected by development (Map F), but
is weak on the long term socio-economic impacts. There is little
discussion of the implications of this growth pattern for low and
moderate income housing and employment opportunities.

There is no attempt, in any holistic way, to identify areas not ①
suitable for development due to commination of air and water
quality and other environmental constraints. One mitigation
measure discussed was to reduce growth in the north and northeast
Denver region based purely on prime agricultural land considerations.
There was no attempt to base this recommendation on a
total picture of environmental constraints. The secondary socio- ②
economic impacts of this recommendation were also ignored; for an
example, there is no comprehensive trade-off analysis of alternate
growth strategies and the potential physical and socio-economic
benefits and costs of each. Without this, the third objective of
the EIS cannot be met, i.e., stimulating public discussion about
desirable environmental goals for the Denver metropolitan region.
HUD is concerned about regional strategies for promoting low and
moderate income housing. There is also no direct consideration of
the relationship of EPA's construction grant program with other
Federal programs, part of this same objective.

There is a significant amount of discussion of governmental and fiscal mitigation measures over which EPA has limited control, yet, there was no discussion of alternative regional growth strategies which have even more significance. There is also a weak discussion of the impacts of alternative transportation control measures in terms of how they could be affected by alternative growth patterns. Reduction of traffic volumes, which the report states is necessary for control of particulates, CO and ozone can be accomplished by directed growth patterns. There is strangely no mention in the summary report of DMTA's decision not to fund mass transit which bears directly on the issue. ①

Other impact interrelationships are omitted. For example, the connection between improvement of recreational uses in various riparian areas and the impact that alternative wastewater flow decisions can have on these is not made in the summary report, although the importance of recreational development as a potential adverse impact is made. There is also little discussion of the connection between energy conservation and alternative land use patterns. ①

Director

RESPONSES TO COMMENTS BY
U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
8 July 1977

1. The objective of the EIS is not to evaluate alternative growth patterns but to assess the impacts of the growth plan being utilized in developing the facilities plans and Clean Water Plan. Mitigation measures for significant adverse impacts which are identified and can be acted upon by EPA are addressed in Volume I.

2. Please see the Introduction to Section [illegible], Volume 2.

THE COLORADO COLLEGE
COLORADO SPRINGS, COLORADO 80903

19 July 1977

Mr. John A. Green
Regional Administrator
U.S. Environmental Protection Agency
1860 Lincoln
Denver, CO

Dear Mr. Green:

The following are personal comments that I would like to pass on ①
with respect to the 208 Clean Water Plan for the Denver Metro
region. First, from an air quality point of view, I strongly
support your conclusion (page I-6) that it is necessary to look
at projected population growth in terms of growth and in terms
of distribution, with the intent being (page V-4) to examine
what strategies and/or plan changes may be most effective in
reducing Denver's air pollution. This broad philosophy and
plan is however severly limited by the following very restrictive
assumption which seems to underlie most of the analysis in the
EIS (page V-4): "...we can be reasonably confident that there is ②
a linear relationship between additional population increase
and increase in vehicle miles travelled (VMT)." Further work
must be done to understand the implications of challenging this
assumption.

I would like to call attention to the following critical conclusions from the EIS:

1. (page V-6) It is not fruitful to utilize restrictive local land use controls which might promote development elsewhere, in order to relieve regional air pollution.

2. (page V-7) A 30 % reduction in 1976 emissions resulted in a 15% reduction in peak ozone.

3. (page V-10) Reductions in traffic volumes may present the most effective method of reducing the particulate air quality problem.

4. (page V-11) After around 1995, any subsequent growth in traffic will cause deterioration of Denver's air quality.

5. (page IV-49) Using the Denver Air Quality Model projections and
conclusion (2) above, it follows that ozone violations ③
would not be projected if there was a 23% reduction
from projected 1985 emission rates and a 14%
reduction from projected 2000 emission rates.

I believe that these conclusions imply the need to extend the Denver ④
208 EIS to evaluate how reductions comparable to those listed in (5)
above might be dependent on region wide wastewater planning.

With respect to the details of the air quality modelling, I would like to know the answers to the following questions:

1. The 1976 model results are based on emission factors from AP-42/5. We know that these emissions are too low by as much as a factor of two in some cases. How can the model start from "wrong" data and get "right" answers in terms of agreement with measured ozone levels? It suggests that the model has been tuned in some ways to get agreement with the observations. A list should be provided of all parameters which were assumed and/or adjusted and the sensitivity of the model results to these parameters should be detailed. (e.g. how critical is the eddy diffusivity parameterization on affecting levels and distributions?) ⑤

2. Why was meterology which produces ozone in the north-east not considered and why was the meterology which was used not included in the appendices? The model should have been tuned up for one set of data and then verified on an independent set of emissions and meterology inputs. ⑥

3. Why was the region chosen to be so small? A 30x30 mile area is by no means large enough to characterize the regional nature of the ozone problem resulting from Denver's automobile emissions. Measurements as far as Ft. Morgan have found ozone in excess of 80 ppb. A visual examination of the brown cloud reveals that it extends well out of the modelling region to the north on essentially every calm morning both in winter and summer. ⑦

4. Why was the estimated impact of air pollution on agriculture limited to Adams, Arapahoe, and Boulder counties when it is known that ozone produced by emissions from the Denver Metro area is impacting the intensively farmed areas to the north and east? ⑧

5. Why was no attempt made to model the air quality which might result from serious efforts to reduce the future automobile dependence of Denverites? Society usually makes choises based on historic trends unless two conditions hold: (1) a serious problem which warrants public action has been identified and (2) believable alternatives to the historic trends are available. This Environmental Impact Statement, as have many other studies, details the problem and gives it considerable weight. However, the EIS does very little to shed light on alternatives which would challenge the assumption that more people means more VMT. The conflicts with the existing population projections, land use plans, and adopted transportation are now clear. Before final decisions are made on future wastewater facilities we must define, study, and evaluate techniques to reduce our automobile dependence. ⑨

Thank You Very Much,

Val R Veirs

Val R. Veirs

Chairman: Colorado Air Pollution Control Commission

Assistant Professor of Physics

RESPONSE TO COMMENTS BY VAL R. VEIRS, CHAIRMAN OF THE COLORADO AIR POLLUTION CONTROL COMMISSION

19 July 1977

1. Please see discussions in Volume 1, subsections III-1 and IV-1.

2. This quote cannot be found and any context in which such an approach was taken cannot be recalled.

3. This is an interesting observation. One should be careful to note, however, that the 15 for 30% relationship was derived from 1976 emissions. Whether or not it would hold for other cases such as year 2000 HC/NO_x emissions is not established.
4. Please see Volume 1, subsection III-1 and IV-1.
5. We are not aware of such deficiencies of AP-42/5. Such errors should be minimal for the 1976 vehicle fleet which was studied for validation exercise. 1985 and 2000 estimates did not use AP-42/5 as discussed on p. 154. In all cases proper altitude effect compensations were made.

   The model was not tuned. A full disclosure of model development is given in Appendix A, Reference 998. The sensitivity studies described in this Reference covered wind speed and mixing depth which were judged to be the most significant meteorological parameters. The references given (Liu et al., 1976b and Lamb et al., 1975) describe the diffusivity parameterization in some detail.

6. Simulations were carried out for all days for which data were available. On 28 July 1976, peak concentrations were to the north of Denver. The highest observed ozone on that day was at Northglenn and Welby. Perhaps the meteorological data should have been included in the report. All data for the validation study were independent data since none was used for tuning since no tuning was done.

7. The region was the largest region for which data were available. The existence of impacts which we had no way of analyzing does not invalidate the analysis of impacts for which data were available.

8. These are the areas within the study area with the majority of regional agriculture and generally downwind of Denver.

9. A 30% reduction in future emissions was modeled and reported. Reductions larger than this would appear difficult to bring about without massive redevelopment of living and working facilities.

State of Colorado
EXECUTIVE CHAMBERS
DENVER

RICHARD D. LAMM
Governor

August 1, 1977

John A. Green, Regional Administrator
U.S. Environmental Protection Agency
1860 Lincoln Street
Denver, CO 80203

Dear Mr. Green:

I am transmitting the comments from the various divisions and departments of the State of Colorado on the Draft Denver Regional Environmental Impact Statement for Wastewater Facilities and the Clean Water Program. Additionally, I have taken the opportunity to synthesize what we believe to be some of the more pressing issues raised by the State agencies.

The Environmental Protection Agency should be commended for addressing a range of issues beyond the explicit jurisdiction of the agency. Your initiative conforms to the spirit of the National Environmental Policy Act and should serve as an example for other federal agencies to recognize that the programs of any one entity are rarely independent of other programs and policies at various levels of government.

Generally speaking, the Draft neglects a significant amount of the Denver
Metro region which in a few short years will have been developed and
expanded in a manner similar to today's near-suburban area. Specifically ①
excluded was northern Douglas County. We feel that the area analyzed
in the Draft should be expanded to include all surrounding county portions
in close proximity to Denver that are likely to be impacted.

We are very disappointed that other federal agencies did not participate
in the environmental impact statement. The statement itself makes a
strong case for policy coordination between governmental programs. But
without the involvement of other federal agencies in the EIS development, ②
it appears likely that the document will become just another academic
exercise that effects little real progress toward solving the problems
enumerated. We are particularly disappointed in view of the clear
direction for interagency coordinated statements set forth in the Guidelines
of the Council on Environmental Quality, Section 1500.7(b).

While it is well recognized that no one controlling measure--such as the
number, location, capacity, and type of wastewater plants--will alone ③
stop or answer the problems which unplanned population growth brings, the
inability of this Draft to present and analyze the strategies EPA and
other Federal funding agencies have to address these problems is glaring.

The three strategies outlined for attacking the wastewater problem-- ②
local, regional, or status quo--are a step in the right direction, but
at some point in time these strategies must relate and be tied to other
federal programs, such as those listed in the attached letter of the
Division of Planning.

In setting aside a portion of the document for the anticipated socio-
economic impacts, the document lacks the information that the develop-
ment of greater wastewater treatment capacity will have on the parallel ⑤
development of human service needs, i.e. health care demands for the
poor, the elderly and the handicapped, social service demands, leisure
time demands, and, in general, human settlement patterns and related
problems common to all large metropolises.

Finally, the Draft fails to adequately consider recent trends concerning
the slowing of the "white flight" to suburbia. Some cursory indicators ⑤
point to a movement of white families back to the city center. Also,
with the relative progress of Urban Renewal, a revitalization in the
downtown area is slowly reoccurring. Further, the Draft has not mean- ⑥
ingfully addressed the possibilities of a substantial decline in per
capita clean water usage and the related reaction this phenomenon may
have on the eight metro treatment plants. It would also have been
helpful to have included samples of draft legislation where additional
state mitigation measures were conceived to be advantagious, e.g.
legislation on land development through use of tax disincentives.

I appreciate the opportunity to offer our comments on the proposed Draft. Please feel free to contact my office for any needed assistance in clarifying these or related points. Please find attached the more specific agency comments relating to this environmental impact statement.

Sincerely,

Richard D. Lamm

RESPONSE TO COMMENTS BY THE GOVERNOR OF THE STATE OF COLORADO

1 August 1977

1. Please see discussions in Volume 1, subsections III-11 and IV-11.

2. We agree that the intergovernmental coordination and policy development are important aspects to adequately improving Denver's environment. Please see proposed actions in Volume 1.

3. Please see discussions in Volume I.

4. Please see the Introduction to Section V, Volume 2.

5. It has been noted under "Population" in Section II, Volume 2, that some cursory indicators point a slowing of the "white flight" to suburbia, with white families moving back to the city center (p. 69).

6. Please see discussions in Volume 1, subsections III-7 and IV-7.

COLORADO DEPARTMENT OF HEALTH
Division xxxSxxxxxx of AIR POLLUTION CONTROL

INTER-OFFICE COMMUNICATION

TO : Robert D. Siek
DATE : July 25, 1977
FROM: William M. Auberle
SUBJECT: Wastewater Facilities and Clean Water Program EIS

An analysis of air quality was performed for this EIS for the purpose of predicting the effect of land use and population forecasts used in planning the eight proposed Wastewater Treatment Facility Plans (201) and Clean Water Plan (208) on future Denver air quality. This analysis was performed by Systems Applications Incorporated (SAI) under contract to EPA and is listed in the EIS bibliography as Ref. 998. Reference 998 is an extensive (460 page) document entitled "Air Quality in the Denver Metropolitan Region 1974-2000." It opens with a "Summary of Results" wherein 14 conclusions concerning the study inputs and Denver's present and future air quality are set forth.

Our comments are directed to these conclusions, first as they relate to the Wastewater Treatment Facility Plans and Clean Water Plan; and, second, but more important, as they may be used by other agencies in decisions affecting land use and transportation planning.

① First, while we do not agree with a major analysis conclusion that the distribution or redistribution of population as could be affected by the size and location of wastewater treatment facilities would have little effect on reductions in air pollution concentrations across the region, we do believe that EPA's funding of the capacity for wastewater treatment and intercept sewer lines necessary to accommodate current growth projections and allocations for the year 2000 will not in itself result in foreclosure on the options available to provide clean air in the Denver Metropolitan Region.

We must, however, carefully examine the assumptions and qualifications upon which this and the several conclusions set forth in the study are based. Without such an examination the conclusions may be misleading and allow an observer to believe that if there does exist an air pollution problem there may be nothing we can do about it.

② The analysis performed by SAI provides the following conclusion with respect to population redistribution: If total regional emissions are unchanged, reduction of HC and NO_x emissions by 25 percent in any given suburb or cluster of suburbs would have negligible effect on local or regional ozone concentrations. From this the inference is drawn in the study "that land use controls that would reduce an area's population by as much as 25 percent without changing the regional population would be ineffective in terms of reducing ozone concentrations." The conclusion should be expected since their simulated redistribution of population was, in effect, a redistribution of emissions which accounted for no more than seven percent (7%) of the emissions on a regionwide basis with total regional emissions remaining constant. Also, this simulation related to ozone only and did not address carbon monoxide and particulates.

Continued

Signature

Redistribution of emissions is not equivalent to redistribution of population. ② The major source of air pollution, either directly or indirectly, with respect to all pollutants studied, is the automobile. Therefore, an appropriate simulated redistribution of population would input an alternative transportation plan to serve that population. This was not included as a part of SAI's simulation. Population distribution or redistribution can not then be excluded as an air pollution mitigating measure to the extent that it could result in a reduction in emissions from the automobile by reducing or eliminating its use.

Carbon monoxide and NO_2 conclusions can be misleading with respect to the impact of these pollutants and the selection of mitigating measures. The study states that "Carbon monoxide concentrations averaged over two-mile square grid cells do not now exceed standards. Standards are violated at smaller 'hot spots'. CO concentrations should be much lower in the future and the number of hot spot violations should decrease." There is no indication in this conclusion of the ③ number of hot spots that might be found in a 2 mile x 2 mile grid; that there may be a dozen or more and a high number of people exposed is not revealed. Averaging CO over a four square mile area results in the masking of the highest CO concentrations. Also, summertime mixing depths were inappropriately assumed for wintertime conditions. Eddies and turbulence caused by high rise construction in the central business district was the rationale given for use of summertime mixing depths. This must be considered conjecture since there is no evidence to support this for the Denver CBD. Mixing depths in the winter are lower and increase CO.

Further, the Air Pollution Control Division's CO monitoring, coupled with traffic count data, contradicts the study conclusions related to the regional nature of CO.

During the SAI study base year, 1974, the Division recorded violations of the 8-hour CO standard at all of its six monitoring stations ranging from 10% of the days at the remote Welby station to a high of 35% of the days at the CBD CAMP station. The average CO levels at all six stations were within 50% of each other. The wide variation of traffic volumes at the stations would suggest a much wider variation in CO levels if CO had only locally determined characteristics. Levels measured at the NJH station were similar to those at CAMP. The residential CARIH station had high levels of carbon monoxide which could not be explained by traffic activity alone. This would indicate that CO not only has a local character, but a regional character as well. SAI's analysis must be considered perfunctory with respect to CO.

The study indicates that the Denver region is probably now in compliance with NO_2 standards;that future NO_2 concentrations cannot be confidently pre- ④ dicted; that conflicting results were obtained with two types of analyses, and that their (SAI's) best estimate is that NO_2 concentrations will not rise markedly over the next three decades if Federal vehicle emissions standards are met. The study, however, also concludes that a relaxation of the 1985 Federal Vehicle Emission factor from 0.4 grams of NO_x per mile to about 1 gram per mile would eliminate violations of the Federal oxidant standard. We cannot accept their best estimate that NO_2 will not markedly increase nor the implied strategy that by permitting higher NO_x levels from auto ozone will decrease. Air quality maintenance analysis work performed by the Division indicates that we will have a maintenance problem in the Denver Region with respect to NO_2. Implicit in the relaxation of NO_x standards is the philosophy to improve air quality in the metropolitan area at the expense of the rural agricultural areas. This we cannot accept.

Finally, we agree that the air quality analysis of the Denver Region was carried out using an improved version of SAI's Air Pollution Simulation Program (APSP) and EPA's Climatological Dispersion Model (CDM), which models had been previously utilized by this Division in its Denver Metro Air Quality Maintenance Analysis (AQMA). The new version of APSP incorporates current atmospheric ⑤ chemistry concepts through use of SAI's Carbon-Bond chemistry model. The significant input into this model was traffic data. A major assumption was compliance with the Federal vehicle emissions standards by use of Federal automotive emission factors published in AP-42, Supplement 5, but adjusted for this altitude. The use of such factors is by no means a fault of the analysis given the inputs available at the time. However, it must be emphasized that AP-42, Supplement 5, has been recognized as underestimating automotive emissions for the Denver Region since its publication. As a result, new vehicle emission factors have been developed and recently published as AP-42, Supplement 8. The point to be made is that an analysis which can have significant influence on land use and transportation decisions would serve better by using current concepts in the emission inputs.

William M. Auberle, Director
Air Pollution Control Division

JVS:pm

RESPONSES TO COMMENTS BY
COLORADO DEPARTMENT OF HEALTH, DIVISION OF AIR POLLUTION CONTROL
25 July 1977

1. The discussion of air quality impacts has been revised and Volume 2, Section IV should be reviewed. The discussions under Subsections III-1 and IV-1 of Volume 1 are also pertinent.

   Many of the comments from the Colorado Department of Health address the report by Systems Applications, Inc., reference 998, which formed the basis for the air quality discussions in this EIS. Following are responses relevant to comments pertaining to reference 998.

2. The motivation in carrying out the land use sensitivity study was to determine the effect on predicted pollution peaks and patterns of changing forecasts of urban growth. This was accomplished by changing the emissions data used by the computer model. The criteria for these changes were:

   > That they be simple so as to most clearly display their effect. Since model input is emissions, not population or traffic, we changed emissions without specifying how emissions might be so changed. In application to someone's forecasts, emissions changes could represent population changes, transportation system changes, changes in other emission sources and/or interdependent changes in some or all of these factors.
   >
   > That the emission changes studied represent patterns rather than overall emissions since the effect of an overall emission changes of 30% was studied in a separate exercise (p. 167, Reference 998).
   >
   > That the emission changes studied by sufficiently large as to represent maximum expected effects obtainable by circumstances or by policy decisions. A 25% change in pattern (i.e., at the expense of one limited area relative to its neighbors) seemed rather severe--certainly as much as a realizable policy might generate. The Air Pollution Control Division correctly notes an important aspect of urban distribution problems. It is difficult to make pattern readjustments sufficiently large as to make a marked impact on regionwide emissions or ozone.

   A final comment is that the land use sensitivity study actually addressed NO_2 and particulates as well as ozone (p. 142, Reference 998).

3. The conclusion which cited that "Carbon monoxide concentrations averaged over two-mile square grid cells do not now exceed standards " was in error. Co standards were found to be violated on this basis. The observation that the number of CO hot spots in a 2 mile x 2 mile grid is not revealed is certainly correct. It would not have been revealed in a 1 mile x 1 mile analysis either, nor, indeed, on any grid scale for which data were available. Our comment on page 31, Reference 998, that "... violation of the NAAQS can surely be found in any major urban area at particularly critical spots such as industrial, shopping center, or stadium parking lots or at busy intersections," together with our grid model result of a 15 ppm 8-hour maximum (56% above NAAQS over 4 square miles) certainly do not mislead the reader as to the magnitude of the problem.

The comment about the conjectural nature of the winter mixing depth has certainly a measure of validity also. Inasmuch as *any* value of mixing depth would be to some degree conjectural, it was important to use the *most* objective estimate. Alternative estimates that occurred to the investigators were:

a) Zero (i.e., a ground based inversion) based on morning temperature profiles at Stapleton airport

b) 300 meters, based on Holzworth's mean winter morning estimate

c) 20 meters based on stability category, Turner's tables and estimated characteristic length

d) 4 meters, based on estimates of traffic wake dimensions used in several line source models (e.g. California Air Resources Board)

e) 50 meters, based on building wake dimensions.

Alternatives a and b conjecture that the atmospheric boundary layer at Stapleton is characteristic of downtown, or that the atmospheric stability is predominantly thermal; mechanical effects are absent. Alternative c conjectures that downtown is an open meadow, and that mechanical turbulence is determined by atmospheric shear rather than obstacles. Alternative d conjectures that the highest concentrations will occur on open, exposed roadways rather than on parking lots or street canyons. Alternative e conjectures that building wakes will extend throughout the space between buildings in the downtown high rise area. We chose the last conjecture as the least misleading for revealing grid-average concentrations in the region of greatest grid cell emissions.

The final comment on CO, that monitoring data contradicts results, does not seem to be justified. No conflict is seen. Some points to note are:

The base year emissions were those for 1976. Only meteorology was obtained from 1974, as an example case.

No grid cell average monitoring was obtained (or is possible).

The average monitoring results should not be compared with peak concentrations from a single modeled day.

Distribution of exceedances from a period of monitoring should not be compared with the exceedances noted on a single modeled day.

It should be emphasized that even on a 4 square mile average basis, peak concentrations well beyond NAAQS were computed and it was stated that actual, local peaks would be much higher and more widely distributed.

4. It is the investigators' understanding that EPA-RTP recognizes the shortcomings of present NO_2 evaluation techniques including the only technique (rollback) that they previously recommended. It is our belief that there is a general consensus that photochemical effects cannot be ignored, but that no satisfactory treatment is now available.

If these understandings are valid, then revealing the ambiguities of analyses and the reasons for them seems the least misleading course of action. Similarly, with regard to the effect of NO_x emissions on ozone, it was felt it would be misleading to not reveal this result, that objection to the result should rest on defects in the model, and that sufficient warnings to the reader of the disadvantages of high NO_2 concentrations should be included so that others can develop informed strategies.

The comments recognize the attempts to meet the concern for valid modeling in the statement "... we agree that the air quality analysis of the Denver Region was carried out using an improved version [of the model] ..." The concern for revealing strategy implications may be found on pp. 36 and 177, of Reference 998.

5. The comments express concern that AP-42 Supplement 5 emissions estimates were, "... by no ... fault of the analysis, ... the inputs available at the time..." (thus apparently they were "current concepts") whereas Supplement 8 emissions are now available and judged more accurate. Supplement 8 was not available at the time the investigations were conducted, but investigators became aware of work on Supplement 8 during the project. To meet the concern for using the best possible inputs, EPA Region VIII provided emission factors that did embody the major findings of studies that led to Supplement 8 and are at least comparable to Supplement 8 factors. These factors were used and reported as "Set 2" factors on p. 160, Reference 998. At the time it was too late to reflect these studies adequately in the report but "Set 2" factor simulations were used and identified as base case predictions in the EIS.

COLORADO DEPARTMENT OF HEALTH
Radiation and Hazardous Materials Control

INTER-OFFICE COMMUNICATIONS

TO : Ron Simsick
DATE : July 18, 1977
FROM : Orville F. Stoddard
SUBJECT: Denver Regional Environmental Impact Statement for Wastewater Facilities and Clean Water Program.

Potential surface and ground water pollution and gas generation problems can result from open dumps located in alluvial deposits or mined out gravel pits in natural drainage areas. The impact of the disposal of solid waste in these areas was not adequately considered. ①

The disposal of solid wastes in sanitary landfills to reclaim marginal land is acceptable. This potential resource was not mentioned in the portion of the report pertinent to agricultural or recreational lands. ①

The recovery of materials and energy from solid wastes and sludge was not mentioned in the portion of the report pertinent to energy. ②

The generation, transportation, and ultimate processing and disposal of hazardous wastes was not addressed in this document. ①

These topics must be given thorough consideration as they have a significance impact.

OFS/pj

Enclosure(s)

Orville F. Stoddard

RESPONSES TO COMMENTS BY THE
COLORADO DEPARTMENT OF HEALTH
DIVISION OF RADIATION AND HAZARDOUS MATERIALS CONTROL

18 July 1977

1. Please see the Introduction to Section V, Volume 2.
2. Please see discussions under Volume 1, subsections III-8 and IV-8.

COLORADO DEPARTMENT OF HEALTH
Division or Section of Rad. and Haz. Mat. Control

INTER-OFFICE COMMUNICATION

TO : Ron Simsick
DATE : July 20, 1977
FROM: Albert J. Hazle
SUBJECT: DENVER METRO DRINKING WATER AND WASTE WATER EIS - RADIOLOGICAL HEALTH.

Two matters in radiation need to be addressed:

One is the radioactive material content of the discharge of waste water treatment plants and the radioactive material content of waste treatment sludge. The Colorado Health Department is currently investigating the situation. ①

The second item is the impact of uranium mine effluent on the Denver Water Board's water supply source is not addressed in the EIS. ①

The above items are my comments which are provided without a thorough review of the document.

AJH:bjw

Albert J Hazle
Signature

RESPONSES TO COMMENTS BY THE
COLORADO DEPARTMENT OF HEALTH
DIVISION OF RADIATION AND HAZARDOUS MATERIALS CONTROL
20 JULY 1977

1. Additional information has been added to the Plutonium Contamination and Radiation Hazard Section of Section II, Volume 2 (p. 62).

Department of Local Affairs
Colorado Division of Planning
Philip H. Schmuck, Director

1876
Richard D. Lamm, Governor

July 11, 1977

Mr. Ron Simsick
Office of Health Protection
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado

Subject: Denver Regional EIS for Wastewater Facilities and the Clean Water Program

Dear Ron:

Because of the breadth of issues raised and the complexity of alternative solutions, we are unable to offer more than general comments on the above-referenced EIS, within the time frame that has been provided for review. However, we feel strongly that these issues should be pursued in more depth, and that the EIS should be considered a starting point in moving toward long term solutions for the environmental problems of the Denver region. The developmental patterns and impacts in this area constitute the State's foremost land use problems, and we should seize the opportunity to address them and attempt a coordinated solution involving local, state, and federal entities.

The Environmental Protection Agency should be commended for realistically projecting the environmental consequences of our present development policies and displaying a range of alternative strategies even though most of them are beyond the control of EPA. Too often we have seen environmental statements which were never able to extend beyond the myopia of one particular agency's jurisdiction. That has not happened in this instance. In fact, the most obvious weakness of this EIS is the failure to relate clearly the specific actions contemplated (the eight wastewater treatment facilities considered for funding) to the larger issues of long term development trends. (For example, it is clear how the wastewater facilities impact immediate stream quality, but not how they drive or detract from future sprawl.) ①

The specific treatment facilities considered are needed urgently and it does not appear wise or feasible to delay them until solutions can be found for the larger problems. Resolution of the long-term problems will likely require several years of effort. As the EIS points out, the future of water quality in the Denver area is not truly dependent upon the alternative technologies available for point discharges. It is more dependent upon non-point discharge. There is even less relation between the specific wastewater facilities and the issues of air quality and energy conservation. ①

520 State Centennial Building, 1313 Sherman Street, Denver, Colorado 80203 (303) 892-2351

Therefore, it would seem reasonable to move first toward a decision concerning the sewage plants, separating that urgent step from resolution of the long-range problems.

From the EIS, several policies emerge which would appear to favorably mitigate future adverse environmental impacts in the metropolitan area. Those policies are: ①

1. Reduction of dependence upon the individual automobile.
2. Consolidation of local, state, and federal jurisdictional divisions in the area.
3. Encouragement of less-consumptive alternatives to the prevalent single-family subdivision.
4. Promotion of water conservation and re-use.
5. Elimination of "leap-frog" development patterns.

Further discussion between the affected entities could undoubtedly add other policies to this list, but these stand out most clearly upon initial review. The EIS does not refine any of these potential policies to the point where implementation strategies could be discussed specifically. EPA has discussed only its own limited implementation tools while freely admitting their impotence to solve the overriding problems. In fact, this limitation is a serious deficiency in the EIS. ①

Guidelines issued by the Council on Environmental Quality §1500.7(b) state: "Where more than one agency...is involved in a group of actions directly related to each other because of their functional interdependence and geographical proximity, consideration should be given to preparing one statement for all the Federal actions involved. Agencies in such cases should consider the possibility of joint preparation of a statement by all agencies concerned, or designation of a single lead agency to assume supervisory responsibility for preparation of the statement... In either case, the statement should contain an environmental assessment of the full range of Federal actions involved, should reflect the views of all participating agencies, and should be prepared before major or irreversible actions have been taken by any of the participating agencies." Many other federal programs impact the issues raised in this EIS. The list would include: ②

FHA/VA home financing
HUD community development grants
Reclamation/BLM/Forest Service water policies
FHwA highway plans
FAA airport improvement grants
UMTA mass transit programs
BOR recreation grants
Small Business Administration programs

I am forced to concur with EPA's conclusion that they cannot affect metropolitan growth problems merely through manipulation of wastewater treatment facilities. However, I am not at all certain that a coordinated program supported and enforced by policies of all of the above-listed agencies would not have a significant effect. And if that program were further supported by the State and key local entities, I am optimistic that meaningful environmental gains could result. Therefore, if we wish to seriously address these problems, I feel it is imperative that we make every effort to force the kind of joint EIS that is envisioned by the CEQ Guidelines. To do so, it appears inevitable that we must somehow divorce this EIS from the eight specific wastewater facilities that cannot await the time that such a massive, coordinated effort would require. ②

I hope that these general comments prove helpful to you in assembling a State position on this matter. I would be happy to work with you further.

Very truly yours,

Charles G Jordan

Charles G. Jordan
Senior Planner

CGJ/btm

Reviewed: Phil Schmuck
Philip H. Schmuck
Director

RESPONSES TO COMMENTS BY
DEPARTMENT OF LOCAL AFFAIRS
DIVISION OF PLANNING
11 JULY 1977

1. Please see discussions in Volume 1, subsections III-1 and IV-1.

2. EPA is in complete agreement with your statement. With the proposed actions EPA plans to take, which are described in Volume 1 of this EIS, it is hoped that the environmental consequences of the projects and 208 Plan will be largely positive, including secondary growth impacts. Although EPA actions are being taken without the level of governmental coordination suggested, our actions may foster similar action by other Federal, State and local agencies.

STATE OF COLORADO
Richard D. Lamm, Governor
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE
Jack R. Grieb, Director
6060 Broadway
Denver, Colorado 80216 (825-1192)

July 5, 1977

Mr. Robert Siek
Associate Director for
Environmental Health
Colorado Department of Health
4210 East 11th Avenue
Denver, CO 80220

Dear Mr. Siek:

It is vitally important to the wildlife of Colorado that waste treatment facilities be designed to prevent any further degradation of Colorado's lakes and streams. ①

All possible measures should be implemented to upgrade Colorado's water quality at the earliest possible time in order to preserve and improve the existing human and wildlife environments. ②

Growth can occur without further degradation of Colorado's waterways and Denver should take the leadership role in accomplishing this goal. Growth control must be actively and accurately studied to prevent over-committment of Colorado's finite water resources. ③

Thank you for the opportunity to comment.

Sincerely yours,

Jack R. Grieb
Director

P.T. Barrows

P. T. Barrows, Chief
Environmental Resources

PTB:cs
cc: Clearinghouse
R. Evans

DEPARTMENT OF NATURAL RESOURCES, Harris Sherman, Executive Director • WILDLIFE COMMISSION, Thomas Farley, Chairman
Sam Caudill, Vice Chairman • Roger Clark, Secretary • Jean K. Tool, Member • Vernon C. Williams, Member
Jay K. Childress, Member • Eric Kelly, Jr., Member • Wilbur Redden, Member

RESPONSES TO COMMENTS BY
THE COLORADO DIVISION OF WILDLIFE
5 JULY 1977

1. Please see discussions in Volume 1, subsections III-3 and IV-3.
2. Please see discussions in Volume 1, subsections III-2 and IV-2.
3. Please see discussions in Volume 1, subsections III-5,6,7 and IV-5,6,7.

RICHARD D. LAMM
Governor

C.J. KUIPER
State Engineer

DIVISION OF WATER RESOURCES

Department of Natural Resources
1313 Sherman Street - Room 818
Denver, Colorado 80203
Administration (303) 892-3581
Ground Water (303) 892-3587

July 20, 1977

MEMORANDUM

TO: ROBERT SIEK, ASSOCIATE DIRECTOR FOR ENVIRONMENTAL HEALTH

FROM: DR. JERIS A. DANIELSON, DEPUTY STATE ENGINEER

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT - DENVER REGIONAL WASTEWATER FACILITIES AND CLEAN WATER PROGRAM

This is to acknowledge receipt of the above referenced Draft Environmental Impact Statement for the Denver region. We have reviewed this report, and basically, have only one comment concerning the impact of the regional wastewater program upon the water resources of the South Platte River and its tributaries. This comment is in regard to the emphasis being placed upon the reuse and/or exchange of effluent with agricultural ditch companies involving waters tributary to the South Platte River basin. We urge the Environmental Protection Agency to require Water Court approval of the plan prior to providing funds to the local agencies proposing the reuse plan. Without the opportunity for other water users to have the ability to protect their water rights through this established process, these water users could be detrimentally affected. Furthermore, a subsequent lawsuit by injured parties could prevent the reuse program from operating and result in a considerable loss of funds expended on a particular plan. ①

Jeris A. Danielson

Jeris A. Danielson

JAD/HDS:mvf

cc: Colorado Clearinghouse

RESPONSE TO COMMENT BY
THE COLORADO DIVISION OF WATER RESOURCES
20 JULY 1977

1. Please see discussions in Volume 1, subsections III-6 and IV-6.

OFFICE OF THE STATE ARCHAEOLOGIST

1300 Broadway
Denver, CO 80203
303-892-3391,2,3

July 21, 1977

RECEIVED
JUL 26 1977
DIV. OF PLANNING

Mr. Philip H. Schmuck
Department of Local Affairs
Colorado Division of Planning
520 State Centennial Building
1313 Sherman Street
Denver, CO 80203

RE: DEIS Denver Regional Wastewater (EPA): archaeological resources

Dear Mr. Schmuck:

The Office of the State Archaeologist of Colorado has received and reviewed the Environmental Protection Agency's Denver Regional Environmental Impact Statement for Wastewater Facilities and the Clean Water Program.

While we agree that a regional approach is efficient (cf. p. ① I-5, I-8) and we applaud EPA's commitment to adhere to "The State and Federal procedures for the preservation of historic and archaeologic [resources]..." (p. V-29), we must conclude that archaeological resources are not adequately addressed in this statement.

The area's (1) rich prehistory is not discussed (cf. p. II-45), and (2) the possible unavoidable adverse impacts upon archaeological resources of both the prehistoric and historic periods are not mentioned (cf. p. VI-1-3, B-8-9). EDA states that "Site reports have been obtained from the Colorado State Archaeologist and are in the process of being mapped for inclusion in the final EIS" (p. IV-92). We have two comments regarding this statement:

First, when the "site reports" were released from the Colorado Archaeological Survey Site Inventory (the state-wide archaeological data repository we maintain), it was with precise instructions to use the data for planning purposes only and not to include specific site locations in any public document, etc. As part of the State Historic Preservation Officer's inventory of the State's cultural resources (those eligible and potentially eligible to the National Register of Historic Places), such data is expressedly waived from the Freedom of Information Act (PL89-665 Title 1 Section 101(a)4). In the interest of the preservation of these fragile, non-renewable resources, we forbid the inclusion of such a map in the final EIS.

Second, the mere listing of the few recorded archaeological resources in the region does not constitute compliance with the various federal mandates involved—NEPA and the CEQ Guidelines, the National Historic Preservation Act of 1966, Executive Order 11593, and 36 CFR 800.

Additionally, the statement does not reveal how EPA will identify previously unrecorded archaeological resources, what provisions will be made for the evaluation of archaeological sites in terms of the National Register of Historic Places eligibility criteria, or how plans for the avoidance or mitigation of adverse impacts upon eligible archaeological resources will be accomplished.

Considering (1) the regional scope of this EIS, and (2) the disturbed ground surface in most of the region, we recommend the ① following approach: the formulation of general historic and prehistoric overviews, the delineation (based upon rigorous research) of areas expected to contain important archaeological resources, and on-site monitoring by a competent archaeologist of all ground disturbance within those "sensitive" areas. This approach will most efficiently accomplish the identification and evaluation of the covert (i.e. subsurface) archaeological resources most likely to be encountered.

We have had some experience with EPA procedures in the Platte-II Sewer Project and while we recognize some of the planning problems of the agency, we believe EPA should more rigorously study their Cultural Resources Management obligations. If we can be of continued assistance, please call upon Staff Archaeologist David R. Stuart at (303) 892-3391. (The State Historical Society's Department of Historic Preservation will independently comment upon architectural/historical resources.)

For the State Historic
Preservation Officer

Bruce E. Rippeteau, Ph.D.
State Archaeologist Colorado

BER(DRS):ng
cc: Hart, SHPO
Wall, Advisory Council on Historic Preservation
Klein, Council on Environmental Quality
Rudy, NPS Interagency Archaeological Services

RESPONSE TO COMMENTS BY
THE OFFICE OF THE STATE ARCHAEOLOGIST
21 JULY 1977

1. Please see the Introduction to Section V, Volume 2, and discussions in Volume 1, subsections III-9 and IV-9. EPA will not publish the archaeological sensitivity map and its supporting information. These materials will be maintained by EPA for use in the review of wastewater facility plans and other similar projects.

State of Colorado
EXECUTIVE CHAMBERS
DENVER

RICHARD D. LAMM
Governor

July 8, 1977

M E M O R A N D U M

TO: Ron Simsick, Colorado Health Department

FROM: Gary Broetzman, State 208 Coordinator

SUBJECT: Response to EPA Draft Denver Regional EIS

The draft EIS seems to evaluate the air and water quality aspects of the ongoing growth and development patterns of the Denver Metropolitan region. As such, it does provide a valuable discussion document on the complexity of the issues involved, both technically and institutionally.

The document seems to fall short in fully identifying possible actions that EPA could take within its air and water program authorities in trying to curtail some of the more obvious impacts. For example, the document discusses issues associated with urban sprawl, point source system configuration, nonpoint sources, water conservation, fragmented institutional arrangements, and lack of water quality and land use linkages in decision-making. Virtually no possible EPA actions are identified, however, for mitigating these problems with respect to the eight wastewater projects involved.

Let me offer a few primary issues:

1. Various options for system configuration were discussed ranging from a more centralized system with a large treatment facility downstream from the MDSDD plant to a more decentralized system. It seems that some resolution of these options is needed in order to decide whether to proceed with several or all of these eight projects. This did not seem to be done. ①

2. Urban sprawl continues in part because the fragmented number and nature of governmental entities involved in wastewater management. The region suffers from this in two respects. First of all, the numerous entities involved make effective program integration and coordination extremely difficult. Secondly, the proliferation of special purpose sanitation districts limits the ability to bring together decision-making of growth and development with air and water quality control. The DRCOG 208 program is moving towards consolidation of the number of these agencies, but ②

from our perspective is placing far too much importance on the special purpose districts as the management agencies. Although EPA may have no choice but to work with the existing management structure with regard to the eight projects involved, it should go on record as favoring the use of local general purpose governments as future management agencies.

3. During the last week in June, EPA recommended to Congress a need to tie water conservation requirements with the award of construction grants for municipal wastewater facilities. Although that could be awkward to implement, there seems to be no question that a much greater emphasis is needed towards water conservation within the Denver region and the State. Such an emphasis would have financial benefits in terms of reducing investments in both water supply and wastewater facilities as well as benefits in terms of reducing our demands upon a limited water resource. EPA could very well take the posture of setting forth a lead time during which a regional water conservation program is implemented prior to proposing any constraints on construction grants for the region. Concurrently, EPA could evaluate in more detail the present and future per capita flow rates incorporated into the designs of the eight projects. ③

4. The draft did not highlight a need for broader integration of water quality and total water management. The DRCOG 208 plan includes considerable decentralization of wastewater facilities. Such a configuration will add opportunities for reuse and successive use of treated wastewater to satisfy a variety of municipal, industrial, and agricultural water supply needs. The effects of such total water management emphasis should be assessed in terms of reducing transmountain diversions and/or conversion of agricultural waters for urban needs as well as the effects of reductions in downstream flows. ④

5. The emphasis given to nonpoint sources in the draft is difficult to comment upon. Although the DRCOG plan report did provide gross estimates of nonpoint pollutant loadings into the receiving waters, the report did not assess specific impacts on beneficial uses. Without the latter, the pertinent impacts of nonpoint sources are difficult to ascertain.. ⑤

Ron, these are the major comments that I can offer. I would suggest that you use them as appropriate in developing a unified State response.

RESPONSES TO COMMENTS BY
THE STATE 208 COORDINATOR
8 JULY 1977

1. Please see discussions in Volume 1, subsections III-3 and IV-3.

2. Please see discussions in Volume 1, subsections III-4 and IV-4.

3. Please see discussions in Volume 1, subsections III-7 and IV-7.

4. Please see discussions in Volume 1, subsections III-3&6 and IV-3&6.

5. Please see discussions in Volume 1, subsections III-5 and IV-5.

STATE DEPARTMENT OF HIGHWAYS
JACK KINSTLINGER EXECUTIVE DIRECTOR

DIVISION OF HIGHWAYS
E. N. HAASE
CHIEF ENGINEER

STATE OF COLORADO

COLORADO STATE PATROL
COL. C. WAYNE KEITH,
CHIEF

4201 EAST ARKANSAS AVENUE • DENVER, COLORADO 80222 • (303) 757-9011

RECEIVED
JUL [illegible]
COLORADO [illegible] HEALTH

July 21, 1977

Dr. Anthony Robbins
Executive Director
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

Dear Dr. Robbins:

The Colorado Department of Highways has completed its review of EPA's *Draft Denver Regional Environmental Impact Statement for Wastewater Facilities and the Clean Water Program* issued in June, 1977. We applaud EPA's recognition that the eight wastewater treatment facilities and the provisions of the DRCOG Clean Water Plan are irrevocably related warranting the development of the subject EIS.

The Department of Highways takes strong exception with the conclusions reached in the "Implementation of Air Quality Mitigation Measures" section (p. v-11). We believe that EPA has critically errored in concluding that ". . . population growth is not in itself the problem, but rather, the air quality problem is more related to transportation." The total population and its distribution in the Denver region *largely* determines the transportation system and therefore the resultant air pollution emissions. For example, if population growth in the Denver region continues to occur in low density sprawl a high dependence on the automobile is unavoidable. With sprawling land use patterns a financially feasible transit system cannot achieve significant patronage. (Note the UMTA denial of funds for RTD's first usable segment.) ①

Therefore, the appropriate question to be addressed in the EIS is: How can EPA's decisions relative to funding wastewater treatment facilities and interceptor sewer lines be used to manage population growth and promote development patterns that can be feasibly served by public transportation, bicycling, and walking thereby reducing automobile use, VMT, air pollution emissions, and energy consumption? The EIS must be considered to be substantially deficient unless this question is addressed in depth. ①

The Department must also take issue with the inference that since the federal government has very limited authority in local land use EPA can do little to improve air quality (p. v-11). Although the federal government has limited authority over local land use, federal assistance and regulatory programs have *major* impacts on local level use. The EIS incorrectly states that the ② federal government has very limited authority in transportation planning decision making (p. v-11). In Colorado, approximately 30% of the transportation investment is federally financed. Further, the region's highway and public transportation plans as well as nearly all individual projects require federal concurrence.

Additional comments on the draft environmental impact statement are attached. Please do not hesitate to contact me if the Department of Highways can be of any additional assistance.

Very truly yours,

Jack Kinstlinger
Executive Director

AP/sks
ATTACH.

COLORADO DEPARTMENT OF HIGHWAYS
COMMENTS ON THE DRAFT REGIONAL ENVIRONMENTAL IMPACT STATEMENT FOR WASTEWATER FACILITIES AND THE CLEAR WATER PROGRAM

Listed below are comments and suggestions for further analyses developed by the Staff of the Colorado Department of Highways on the subject DEIS.

- The carbon monoxide (CO) analysis in the "Air Quality Impacts" section (IV-42) is seriously flawed by the averaging of concentrations over a four square mile grid cell. This results in the masking of the highest CO concentrations (p. IV-47). ③

- Although the Department of Highways has used the CDM to simulate particulate emissions, the Department questions the validity of model's basic assumption that particulate emissions are directly proportional to VMT. Further, work is needed to determine if this assumption is correct for the Denver situation and therefore which strategies would be effective (p. iv-49). ④

- The draft statement is deficient for excluding Douglas and Weld counties in the impact analysis. Obviously, relevant information was not easily accessible for the counties since they are not members of the Denver Regional Council of Governments (DRCOG); however, difficulty in obtaining information is no excuse for such a serious error. The boundaries of analysis should have been determined by including all the surrounding county portions which are in close proximity to Denver and therefore are most likely to be impacted - not by informational and modelling convenience. The seriousness of this omission was especially apparent in northernDouglas County were rapid development of urban sprawl is already occurring. In addition, much of northern Douglas County is within the service area boundaries of the proposed Littleton-Englewood wastetreatment plan and the Cherry Creek/Goldsmith Gulch 201 area. (Refer to wastetreatment map). ⑤

- The draft, in its analysis of the projects' relationships to plans and policies did not examine the proposed regional growth and development policies developed by DRCOG. These proposed policies should be examined because they will be used as a guide for future development in the region. ⑥

- There is little consistency between the map of wastewater treatment facility boundaries and the map of urban service areas developed by DRCOG. If the urban service area concept is to be adhered to these two sets of boundaries need to be consistent. ⑦

- The maps accompanying the draft do not show where major interceptors or collection lines will be laid. Therefore it is virtually impossible to tell precisely where within each identified 201 study area severed growth may occur. Without this information we must assume that the study areas are to be completely developed. It is doubtful whether such development would be economically feasible or desirable. ⑧

- The vehicle miles of travel (VMT) on Page A-71 is too low for the population estimate. This was the result of using the RTD/SMC model which may under predict the actual year 2000 VMT. The population figure being used is about 2,000,000, rather than the 1,800,000 as shown in A-10. The RTD/SMC model was not formally adopted by the MPO, and therefore, the results of model should not be used. ⑨

- Any reference to I 470 should be changed to SH 470 as a result of the I 470 study. ⑩

- Colfax Avenue runs east-west and cannot be described as going from the CBD to Englewood (See Page A-71). It should read Broadway from the CBD to Englewood. ⑪

- On Page IV-86 under traffic, the dependence on the RTD bus fleet for the long term should be expanded to include preferential treatment of high occupancy vehicles, such as exclusive lanes, ramp bypasses at freeways. ⑫

- On Page I-70, the statement is made that as population increases, people will live at greater distances from the CBD and other activity centers; and absolute and per capita VMT will likely increase. This statement is somewhat in error. The existing land use plan does not contain fully developed activity centers. This limits the number of opportunities for completing trips with minimum amount of travel. However, once all activity centers are fully developed, the opportunity to make shorter trips will be increased due to the number of increased businesses closer to the home and thereby may result in a lower VMT per capita. It is agreed that the absolute VMT will increase, but this cannot be eliminated as long as the population increases. ⑬

- The draft report did not mention the fact that the transportation planning process, consisting of DRCOG, RTD, and CDH, is in the process of developing a transportation systems management plan that will make better use of the existing transportation system. Such things as ramp metering, preferential treatment of HOVs are only a few of the areas being investigated. These strategies are designed to conserve energy and improve air quality. ⑭

- A major flaw of the analysis would be the fact that only one land use plan was assumed with each alternative treatment concept presented. It would have been more appropriate to examine alternative land use plans in conjunction with each set of alternative treatment concepts. These alternatives could be tested to determine the cost of attaining the specified goals and objectives as they relate to meeting water quality standards. ⑮

- It would be helpful to include the population figures for each analysis year by urban service area. This would allow for a better determination of consistency with the land use data used in the transportation and other planning processes. ⑯

- The document contends that the construction or improvement of facilities in the metropolitan area will result in further urban sprawl. It can be demonstrated that the do-nothing alternative for controlling urban development will not work. In fact, this is the worst alternative as it relates to energy consumption for improving air quality. The transportation system is a servant of the land use plan. ⑰

- The statement does not contain an analysis of how many new residents/ or sewer connections each service area will have to attract on an annual basis in order to pay off their annual debt service. An analysis of this sort would give an indication of where and at what rate growth would have to occur for the provision of sewer services to remain economically feasible. ⑱

- On page III-1 the statement is made that "the Clean Water Plan is concerned primarily with non-point sources of water pollution, and secondarily with point sources." Based on our previous review of DRCOG's Clean Water Plan and the official state comments made by the Water Quality Control Commission we feel that this statement is incorrect and should be deleted. The absence of specific control measures and management techniques and implementing agencies in the Clean Water Plan supports this opinion. ⑲

- In the discussion of mitigation measures the suggestion is made that the number of special districts should be reduced. The Department of Highways agrees with this opinion and urges EPA to evaluate the consistency of this recommendation with the structure of the point source management agencies. ⑳

- To mitigate the impacts associated with the conversion of agricultural lands EPA suggests the adoption of strong tax disincentives to be imposed on transactions involving agricultural lands. Experience in other states suggest that these disincentives need to be extremely severe or that development rights for agricultural lands need to be acquired (fee simple or easements) by governmental jurisdictions. The Draft should have included draft legislation to implement this mitigation measure. ㉑

- Page I-11, Table I-A: If the decision option of Treatment Plant capacity and timing will affect agricultural land turnover, it must certainly have a socio-economic impact. Should have marked this column. ㉒

- Page II-4, Paragraph 1: In an inversion temperature increases with height, not "decreases". This error should be corrected. ㉓

- Page II-63, Table II-P: Douglas and Weld County should not be included in this table if no information was gathered on them. The inclusion of zeroes for this failure to gather information is misleading. Either reliable data should be placed on the table or these two counties should be left out of this particular table. We strongly suggest the former. ㉔

- Page II-64, Paragraph 1: Because some of the counties near Denver are not members of DRCOG and are not covered by the empiric model does not exclude them from development pressures. This has been empirically disproved in northern Douglas County. This is a total error. ㉕

- Page III-2, Top: Local control of waste treatment plants may have an unfavorable effect on water quality. This is because smaller jursidictions with the commensurate smaller financial bases are more cost conscious. Consequently, sophisticated treatment methods may be passed up. Also, a regional treatment plant would facilitate unification of objectives so that the occurrence of discharing effluents overflows and thus water quality problems "down the stream" would be minimized. Finally, the presence of increasing ㉖ returns to scale would make a regional treatment plant favorable to water quality. Smaller treatment plants, with smaller user demand, would be less likely to fully utilize the expensive capital investments necessary for sophisticated treatment methods. Because of this, local jurisdiction with smaller plants would be reluctant to make these investments. However, a large regional plant would have a large demand and thus could more fully utilize the capacity of such investments, making them economically sound.

- Page III-2, Paragraph 2: By stating that the controlling of non-point sources to the extent of meeting 1983 goals is a minor improvement in water quality, it is inferred that either water quality, from a non-point source perspective, is not a problem in Denver, or that the 1983 goals are too modest to be effective. This statement should be clarified. ㉗

- Page III-18, Paragraph 1: Water rights agreements which are clearly archaic and lead to inefficient water use should be changed. This should be discussed. ㉘

- Page IV-4, Paragraph 1: The fact that cities are noisy and congested is a real problem. Actual empirical observations can be made everyday. The blatantness of these problems is illustrated by the creation of federal, state and local government bodies to deal with such problems. ㉙

- Page IV-4, Paragraph 1: Marginal economic analysis is presently and is expected to be in the future, a very limited foundation for basing conclusions. Certainly basing conclusions on economic value versus city size with one study, plus on a marginal analysis, is grossly inadequate. The validity of the study is doubtful since it could not have accurately incorporated, with specific values, all the externalities which city growth produces. Also, it may be argued that many of our largest cities are now suffering economically because of their size. The analyst is advised to observe the economic situation of New York City in which size has contributed to increasing probability of mismanagement, large capital investments with long return periods, the allowance for the development of powerful unions which increase the deficit between revenues and costs, and the adverse effect of size on noise and air pollution and congestion which tends to lower the desirability of the city for both residing and working purposes. We need cities, but the idea that economies of scale are always present with an increase in size or don't become exhausted until the city is a megalopolis is absurd. If marginal benefit were clearly above marginal costs then the flight of the higher income groups and businesses would not be occurring. ㉚

- Page IV-4, Paragraph 3: Economic growth is frequently favorable in the shortrun, however, in the longrun, unrestrained rate of growth in the economy can be devastating to an urban area. Denver's present growth is primarily due to its naturally beautiful surroundings and the potential energy development. The attractive location has drawn a large inflow of highly skilled labor which has resulted in a very attractive location for high skill demanding industries. If economic, and therefore, population growth continues unrestrained, however, the attraction to skilled labor of a "beautiful area" will be eliminated consequently, not only will the inflow of skilled labor be reduced, but an actual outmigration of this labor force would be probable. This result will make it less attractive for businesses to locate here and could cause an outmigration of existing Denver based businesses. ㉛

- Please change the spelling of Governor "Lamb" to "Lamm" throughout the draft. ㉜

RESPONSE TO COMMENTS BY
THE STATE DEPARTMENT OF HIGHWAYS
21 JULY 1977

1. Please see discussions in Volume 1, subsections III-1 and IV-1.

2. Please see discussions in Volume 1, subsections III-1&4 and IV-1&4.

3. The grid cell analysis certainly does mask the highest CO concentrations, as the SAI report stated on pp. 31, 71, and 93. This finding is supplemented by discussions of the nature of the effects that produce the highest concentrations. Since the highest concentrations cannot be confidently modelled and occur too commonly for all to be observed by practical monitoring systems, the citizen is probably best served by noting and explaining the existence of the maxima. See also response to Colorado Department of Health, comment #3.

4. Agreed the approach used was the best available, but has shortcomings as we noted on page 33, reference 998. It seems unlikely that more adequate analyses would change any results qualitatively and thus have any significant policy implications.

5. Please see discussions in Volume 1, subsections III-11 and IV-11. Regarding air quality, the reader is warned in several passages of extraregional impacts.

6. Please see discussions in Volume 1, subsections III-9 and IV-9 and Volume 2, page 78.

7. Agreed, except Map J boundaries are of facility planning areas and not necessarily areas to be served by a particular facility. Also see discussion in Volume 1, subsection IV-1.

8. See figures III-A, III-B, and IV-B, of Volume 2.

9. This correction and note are hereby incorporated into the draft EIS' Appendix document by reference. The material noted was included in error in the EIS. The air quality analysis used population and traffic levels developed by CDH and DRCOG.

10. Correction incorporated.

11. Correction incorporated.

12. This recommendation has been included in the Traffic section of Section IV, Volume 2.

13. Correction incorporated.

14. This information has been incorporated into the Traffic section of Section II, Volume 2 (p. 62).

15. DRCOG's forecasts of land use and population were used throughout the EIS as the only common and accepted regional projections. Variations in land use and population were explored in the Mitigating Measures section of the Draft EIS and were used in developing the actions EPA proposes as explained in Volume 1 of this final EIS.

16. See Table IV-H of Volume 2.

17. Continuation of urban sprawl is forecast, and wastewater treatment facilities, as is the transportation system, are designed to accommodate growth. The no-action alternative must be examined in all EIS's, and was not intended as a growth-controlling mechanism.

18. See revised socio-economic impacts sub-section of Section IV, Volume 2.

19. Correction made. See discussions in Subsections III-5 and IV-5 of Volume 1.

20. See discussions in Volume 1, subsection III-4 and IV-4.

21. See discussions in subsections III-9 and IV-9 of Volume 1.

22. This Table has been deleted in the final EIS.

23. Correction made in Section III, Volume 2, pg. 17.

24. The error in Table II-P has been corrected by deleting the zeroes and entering the note "no available data." Lines for Douglas and Weld Counties remain on the Table to note a lack of potentially useful data (p. 74).

25. This paragraph has been amended in Section II of Volume 2 to correct the error (p. 75, paragraph 1).

26. Comment noted. There are a number of complex issues revolving around local vs. regional approaches. See discussions under Subsections III-3&4 and IV-3&4 of Volume 1.

27. Water quality impacts discussion of Section IV, Volume 2 clarified.

28. Please see discussions in Volume 1, Subsections III-6 and IV-6.

29. No response required.

30 and 31. Clarifying amendments appear in Chapter IV of Volume 2 in response to these comments.

32. This error has been corrected in the Final EIS.

THE STATE HISTORICAL SOCIETY OF COLORADO
Colorado State Museum, 1300 Broadway, Denver, Colorado 80203

August 5, 1977

Mr. Robert Siek
Associated Director for Environmental Health
Colorado Department of Health
4210 East Eleventh Avenue
Denver, Colorado 80220

RE: Denver Regional Environmental Impact Statement for Wastewater Facilities and the Clean Water Program

Dear Mr. Siek:

This office shall comment concerning only architectural and historical properties that may be located within the potential environmental impact area of this project; the office of the State Archaeologist will respond separately concerning archaeological properties.

It is our understanding [based upon 40 CFR Part 1500.9(2)] that compliance with the environmental requirements of Section 102(2)(C) of the National Environmental Policy Act should include compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and with Executive Order 11593. Toward that end, we note that the Environmental Protection Agency (EPA) has identified the major designated properties of architectural and historical value within the Denver Metropolitan area.

The statement also contains a discussion of the potential effects that the construction of wastewater facilities may have upon these properties. The potential effect identified by EPA is that of vibration caused by execavation and removal of materials for conduits and facilities. It appears that the EPA has overlooked several other, potentially more harmful, effects of construction of wastewater facilities. ①

First is the direct effect caused by excavation upon archaeological and historical archaeological material. Conduits, if located in areas that hold remains of Indian and Euro-American activities, can destroy much valuable historical information. To avoid this adverse effect, we recommend that the EPA undertake an identification program to pinpoint those areas that are most likely to contain archaeological remains. This would establish full compliance with the National Historic Preservation Act of 1966 and permit efficient construction of the wastewater conduits and facilities. Certainly provisions should be established to watch for and protect any cultural remains unearthed during ground disturbing activities.

Secondly is the indirect effect upon cultural properties caused by the pressures of growth that increased sewage capacities would permit. As additional subdivisions and developments are made possible, historical structures and archaeological remains may be endangered. While the effects of growth may be unavoidable, certainly contingencies to deal with these effects could be addressed.

A discussion of these effects and potential mitigation could appropriately be included in the discussion of the impacts upon cultural properties within the Denver metropolitan area. Further exploration of these effects and feasible mitigation could be contained within the site specific environmental impact statements.

We look forward to working with the EPA to establish full compliance with federal preservation law. Please contact Michael Quinn of this office at 892-3394 or at the above address if we may be of assistance.

FOR THE STATE HISTORIC PRESERVATION OFFICER

Sincerely,

James Edward Hartmann
Curator, Historic Preservation

cc: John Green (EPA) ✓
Advisory Council
Council on Environmental Quality

RESPONSE TO COMMENTS BY THE STATE HISTORICAL SOCIETY OF COLORADO
5 AUGUST 1977

1. Please see the Introduction to Section V, Volume 2, and discussions in Volume 1, subsections III-9 and IV-9. EPA will not publish the archaeological sensitivity map and its supporting information. These materials will be maintained by EPA for use in the review of wastewater facility plans and other similar projects.

MEMORANDUM

TO: Ron Simsick

FROM: Water Quality Control Division

DATE: June 28, 1977

SUBJECT: Denver Regional EIS for Wastewater Facilities/Clean Water Program

The Division has received and reviewed the above mentioned project and has the following comments:

Improved Wastewater Treatment (Summary Report, page 25): The statements made in this discussion were apparently based on DRCOG's predictive modeling. Although, in general, they may be true, the non-point source assessment that DRCOG conducted on non-point runoff was not comprehensive or definitive enough to assign numerical values to levels of treatment better than secondary. The Division does not believe that it is accurate to state that "All other pollutants are dominated by non-point sources contributing to water pollution upstream of the Metro discharge." The reoccurrence interval of rainfall and snowmelt events should be checked to see how many days of the year this statement could be true. ①

In the same section, the Division can see no reason to go to better than secondary treatment and lower BOD, S.S., PO_4, NH_3, and NO_3 if the effluent is to be used for irrigation. This section should be rewritten with a little less positiveness and raise the questions of non-point source controls as issues to be resolved by additional monitoring. Otherwise, we will buying status quo with very little chance of improving water quality through the Metro area. ②

Major Unavoidable Adverse Impacts (Summary, page 35): The Division has a policy of secondary treatment and disinfection prior to discharge for effluent used for irrigation purposes. We also understand the Governor's Scientific Committee is also making this recommendation after studying land application criteria for the past several months. ②

RESPONSES TO COMMENTS BY
THE STATE WATER QUALITY CONTROL DIVISION
28 JUNE 1977

1. Please see discussions in Volume 1, subsections III-5 and IV-5.

2. Please see discussions in Volume 1, subsections III-3 and IV-3.

AL MEIKLEJOHN
State Senator
7540 Kline Drive
Arvada, Colorado 80005

Senate Chamber
State of Colorado
Denver

COMMITTEES
Vice Chairman of:
Finance
Member of:
Local Government
State Affairs

July 25, 1977

The Environmental Protection Agency
1860 Lincoln Street
Denver CO 80295

In re: 208 Water Quality - Denver Region

Gentlemen:

I am the elected State Senator from Senate District 16. That District includes all of North Jefferson County, portions of the southern part of Boulder County and all of Gilpin County. Included within this District are most of the City of Arvada, portions of Westminster, Broomfield and Boulder and all of Central City and Black Hawk. All in all, there are approximately 60,000 adults and a good many thousands of young persons and children. I would estimate that I represent 80,000 to 90,000 persons.

The 208 Water Quality program for the Denver region is of upmost importance to the people whom I represent.

You have before you two plans with reference to water quality for the Denver region. One involves no federal funding and the other involves significant contributions on the part of the Federal Government. ①

Water quality is of course vital to the Denver region and to the citizens whom I represent. The expenditures involved in these plans would be substantial. Quite clearly, the communities themselves cannot undertake these projects with their own financial resources. They simply do not have the money.

I urge you to adopt the Water Quality Plan which will involve substantial assistance from the Federal Government. These funds are available and the people whom I represent are entitled to have this aid. Should you adopt the plan which involves no Federal funding, it would be a calamity. It appears that next year alone there should be some four million dollars available in Federal funds to assist in this water quality

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July 25, 1977

The Environmental Protection Agency
Page Two

project. Quite clearly, your agency should authorize this.

For myself and on behalf of those whom I represent, I urge you to adopt the federally funded plan and to authorize the expenditure of at least this four million dollars during the ensuing year.

Yours very truly,

Al Meiklejohn

Al Meiklejohn
State Senator
District 16

AJMJr:pad

RESPONSE TO COMMENTS BY
STATE SENATOR AL MEIKLEJOHN
25 JULY 1977

1. Please see Section III, Volume 2 and all of Volume 1.

city of arvada
8101 RALSTON ROAD
ARVADA, COLORADO 80002
PHONE 303-421-2550

July 18, 1977

Environmental Protection Agency
1860 Lincoln Street
Denver, CO 80295

RE: EIS for Wastewater Facilities
and the Clean Water Program

Attn: Bob Doyle

The Statement, contrary to its title, dwells too much, on all consequences of growth ①
and not enough on the specific questions concerning impact from construction of
wastewater facilities. The Statement also leads the reader to the conclusion that ②
the only proper thing to do is to stop growth and suggests that one way to do it is
by not financing wastewater facilities. Such a suggestion flys in the face of the
national goal to clean up our water.

Specifically, the City of Arvada believes that more attention should be focused on ②
the impact from action proposed in the 208 Clean Water Plan and 201 Plan Alternatives for Clear Creek. The proposed plans for Clear Creek recommends transportation of wastewater from the basin to the Metro District Plant for treatment and then discharge to the South Platte River. In the long run, such action will result in lower flows in Clear Creek as compared to a treatment plant located in the basin which discharges back into Clear Creek. Lower flows in Clear Creek obviously will affect the efforts to achieve fishable, swimable waters.

The City of Arvada concurs with comments submitted by the Metropolitan Sewer District.

Sincerely,

Don F. Allard

Donald F. Allard
Deputy City Manager

DFA/sc

RESPONSE TO COMMENTS BY
THE CITY OF ARVADA
18 JULY 1977

1. Please see the Introduction to Section V, Volume 2.

2. EPA will fund additional municipal wastewater treatment facilities under terms and conditions described in Volume 1 of this final EIS. EPA will not support at this time the Clean Water Plan recommendations for the Clear Creek planning area. See discussions in Volume 1 subsections III-3, 6; and IV-3, 6.

CITY AND COUNTY OF DENVER

W. H. McNICHOLS, JR.
Mayor

DEPARTMENT OF PARKS - RECREATION

1805 BRYANT STREET
DENVER, COLORADO 80204

June 21, 1977

Mr. John A. Green
Regional Administrator
U.S. Environmental Protection Agency
Region VIII
1860 Lincoln Street
Denver, CO 80203

Dear Mr. Green:

I have reviewed the Draft Environmental Impact Statement for the Denver Regional Wastewater Facilities and Clean Water Program. I can not find anything wrong with this as it relates to Parks and Recreation.

We know that we need to accelerate development of parks and acquire more land for park, open space and recreational use. However, it boils down to just one thing, available money - of which there seems to be very little. Just to bring you up to date with the existing population of Denver alone all of the land and facilities we would need just to keep pace would be close to $35 million. ①

I agree with the regional tax base sharing plan. Denver foots the bill for many of the facilities while the surrounding counties use those facilities, most of the time for free. Yet we get stuck with all of the problems and welfare loads which cuts into our development, operation and maintenance. ②

One thing that is mentioned is that growth should be discouraged in the North and Northeastern portions. Denver annexed a great deal of land out in that area for development but with shortages of water and natural gas taps for awhile, development will be delayed for many years. In this area we had some larger park areas along with neighborhood park sites set aside by the developers. We were also to receive two large land areas for development of 2-18 hole golf courses which were going to be built soon according to annexation agreements. Since no development has taken place in these areas, we assume these may not be valid. In one case, the larger developers are now bankrupt, and the development status is up in the air. ①

A great deal of existing park development exists along Cherry Creek and Goldsmith Gulch in Denver. We plan on doing a great deal more. It is assumed that extensions of any sewer lines in these areas will not affect this development. ③

If you have any further questions or need additional information, please call me on 297-3155.

Sincerely,

John E. Dillavou
Assistant Director
Parks Planning and Engineering

JED:kr

RESPONSES TO COMMENTS BY
THE DEPARTMENT OF PARKS - RECREATION
THE CITY AND COUNTY OF DENVER
21 JUNE 1977

1. Please see discussions in Volume 1, subsections III-9 and IV-9.
2. Please see discussions in Volume 1, subsections III-4 and IV-4.
3. Please see discussions in Volume 1, subsections III-10 and IV-10.

CITY AND COUNTY OF DENVER

W. H. McNICHOLS, JR.
Mayor

DEPARTMENT OF PUBLIC WORKS

WASTEWATER MANAGEMENT DIV.
5055 WASHINGTON STREET
DENVER, COLORADO 80216

July 19, 1977

Mr. John A. Green
Regional Administrator
U.S. Environmental Protection Agency
Region VIII
1860 Lincoln Street
Denver, Colorado 80203

Dear Mr. Green:

Re: Draft Environmental Impact Statement for the Denver Regional Wastewater Facilities and Clean Water Program

Pursuant to your notice of June 3, 1977, requesting a review and comment on the draft Environmental Impact Statement (EIS) for the Denver Regional Wastewater Facilities and Clean Water Program, the following comments are offered for your consideration:

① The draft EIS covers the many inter-related environmental issues surrounding growth in the Denver Metropolitan Region; however, it is difficult to determine from the text of material whether the "purpose" of the statement has been properly addressed and what EPA's position will be regarding financial participation in the implementation of current and future projects and the 208 plan. The question of controlling growth because of its impact on existing environmental problems appears to be the main issue of this statement. It is the contention of the City that continued growth is not only essential for the maintenance of a viable urban setting, but continued growth is and always has been our goal. To this extent the City and County of Denver has conscientiously worked toward the preservation of environmentally sensitive areas and has continually attempted to achieve a reasonable balance in its development between different land uses and activities. Therefore, the City cannot permit repression of its development activities and responsibilities to provide the services and quality of life its citizenry expect and warrant because of unrealisticly imposed environmental requirements. In addition, it is our considered opinion that this Statement, while comprehensive in scope, is generally inadequate from the following perspectives: (1) It unduly concentrates on the apparent negative environmental effects of the proposed Facility Plans and Clean Water Plan; it has not fairly presented the positive factors associated with these planning efforts; and (2) While being sufficient for those individuals specifically involved and technically attuned to the environmental process, the Statement is very difficult for the layman to understand and effectively comment on.

② Contrary to the statement on page X-1, first paragraph, which states "the water quality goals will not be met by the 208 Clean Water Program," the City and County of Denver takes this opportunity to voice its unequivocable support of the 208 Program. This Program's provisions are realistic and are directed toward the achievement of the national water quality goals in a reasonable time framework. This Program was achieved through the mutual cooperation of all parties involved. The Program recognizes that the multi-jurisdictional composition of the Denver metropolitan area will present problems in the implementation of its provisions; however, the Program has made significant strides to improve upon this given system by the proposed establishment of basin-wide wastewater management agencies. This multi-jurisdictional composition has functioned most effectively to this time and has not prevented the achievement of many notable regional accomplishments, such as the creation of the Metropolitan Denver Sewage Disposal District No. 1, the Urban Drainage and Flood Control District, as well as the Denver Regional Council of Governments. The City and County of Denver strongly suggests that the EPA re-evaluate this region's initiatives in the areas of environment, regional services, etc., and its locally implemented accomplishments; the results of such an investigation should provide the assurances that were evidently not apparent to the EPA consultant in the initial work leading to the draft statement.

③ The Draft Statement continually stresses that water quality goals in this region will not be met because of the pollutional loading from non-point source discharges. A statement on page V-14, third paragraph, states that "future structural controls are likely to be limited to commercial and industrial areas of the region as there is significant evidence that the majority of a number of non-point sources of pollution originates from these areas." The 208 Clean Water Plan recognized the lack of data in this area and proposed an extensive non-point source sampling and monitoring program to provide the basis for determining the type, extent, and appropriate control measures, either structural or non-structural with which to address the non-point source pollutional problem. Furthermore, the 208 Plan recognized the limitations in improving water quality because of the lack of non-point source management agencies but was quick to point out that, through its continuing planning process, this issue will not only be addressed but also resolved.

② The draft repeatedly makes the point that it will not be possible to meet the requirements of PL 92-500 for Denver region's water bodies to comply with the 1983 goals for a quality suitable for swimming and fishing because of the pollutional loadings from non-point discharges. The draft also points out the financial difficulties that cities would have in attempting to achieve these national goals. If the EPA recognizes these deficiencies on a national scale, it would seem appropriate that the EPA initiate appropriate action to modify the law to establish realistic requirements, dates, and provide necessary funds to local governments. This would then permit initiation and implementation of reasonable programs to address the non-point pollutional problem. The financial burden, which would otherwise be placed on local governments to comply with the mandates of the public law, given the other equally demanding urban problems, would be devastating. It serves no purpose to establish national goals as zero discharge of pollutants and swimable-fishable waters, to establish deadlines, permit limits of allowable pollutants, or impose penalties, if it is known that time restraints are impossible to meet and the costs are of such a magnitude that they are simply out of reach.

No one should contest the desirability of a pure environment. However, the facts of life dictate otherwise; and it is recognized that the need to clean up our environment is essential. However, it cannot be done in a "great leap forward" and must proceed on a common-sense basis. Essential needs must first be determined and then receive priority consideration. As an example, in the field of wastewater management, it is of no avail to expend vast sums to establish warm water biota and bodily contact stream classifications if the subsurface collection systems, sewers if you will, are old, leaking, and in various stages of extreme deterioration. It is believed that this is a general condition throughout the United States, if not the world. Recognizing this, it is difficult to reconcile the fact that under the implementation of Public Law 92-500, the major emphasis was for funding of treatment plants. If wastes cannot be transported properly to these plants, they cannot be properly treated. The result is pollutants which are distributed throughout the trace of the various collection systems and eventually find their way into the natural drainage features. ②

The draft EIS does not address the potential impact on the environment based on the non-implementation of the projects covered in this document and the continuation of growth in the region. A comparison of the probable impacts on the environment with and without the implementation of the proposed project and the 208 plan should be included in the EIS to provide necessary information on the relative impacts of growth on the region's environment. The contemplated projects are planned to mitigate existing problems as well as prevent their recurrence by making allowances for moderate growth; therefore, it is recommended EPA support their implementation and provide to local entities the necessary funding to improve and protect the region's environment. ①

The following comments are intended to correct, clarify, and modify a number of inaccuracies within the draft text.

1. Page II-61, Table II-0, the entries for the City and County of Denver User Charges should be corrected as follows: ④

   Third column - 101 percent of water rate in effect as of December 31, 1973; water rate equals $.49/1000; fifth column - 150 percent of water rate plus a surcharge; columns seven and eight, both commercial and industrial tap fees are set--per rate schedule as developed by the Manager of Public Works.

   The reference for the above information is Article 167 of the Revised Municipal Code of the City and County of Denver.

2. Page III-8, fourth paragraph, states the Cherry Creek and Goldsmith Gulch service area is "within the jurisdiction of Metropolitan Denver Sewage Disposal District No. 1." The word "jurisdiction" without the proper qualifiers, is incorrectly used in this paragraph. The only jurisdictional authority possessed by the Metropolitan Denver Sewage Disposal District No. 1 is planning as it affects their plant expansion. The area is, however, within the complete jurisdictional authority of the City and County of Denver. ⑤

3. Page III-9, fourth paragraph, states that "the five Sand Creek sub-basins are administered by the Metropolitan Denver Sewage Disposal District No. 1." This statement is misleading. The City and County of Denver administers that sub-basin which is totally within its boundaries (Westerly Creek); the flows within this area are transported to a Metropolitan Denver Sewage Disposal District No. 1 interceptor and plant for primary and secondary treatment. ⑤

4. Page V-10, fourth paragraph, the need to determine the effectiveness of "street cleaning" as a control measure for improving both air and water quality through the use of "demonstration studies" is essential. However, it is suggested that these studies be extended in scope to include all other similar control measures, such as catch basin cleaning, street salting, etc. ③

I trust these comments will be helpful in revision of this draft statement. If there are any questions concerning the comments contained within this report, please feel free to contact this office at your convenience. The opportunity to participate in this review process is appreciated.

Very truly yours,

J. Zohn

J. Zohn, P.E.
Director

JZ:clj

RESPONSES TO COMMENTS BY
THE DEPARTMENT OF PUBLIC WORKS OF THE
CITY AND COUNTY OF DENVER
19 JULY 1977

1. EPA believes the scope of the draft and final EIS is appropriate to its larger responsibility of protecting the environment. The EPA has no mission to control growth per se. The draft EIS was to aid EPA in reaching a position which is explained in Volume 1 of this final EIS. For additional material responsive to these comments, please see the Introduction to Section V, Volume 2.

2. The Clean Water Plan recommended by DRCOG, has been significantly altered by the conditions imposed by Governor Lamm. These conditions plus others proposed by EPA specifically address water quality goals and stream classifications. See discussions in Volume 1, subsections III-2, 4 and 5; and IV-2, 4 and 5.

3. Please see discussions in Volume 1, subsections III-5 and IV-5.

4. These corrections have been incorporated into Section II, Volume 2 (p. 73).

5. These distinctions have been made by amending the referenced paragraphs in Section III, Volume 2 (pp. 93 and 94).

RICHARD P. LUNDAHL
DIRECTOR OF PUBLIC WORKS
CITY OF NORTHGLENN, COLORADO
TESTIMONY AT EPA PUBLIC HEARING
DENVER REGION EIS
JULY 18, 1977

MR. CHAIRMAN, LADIES AND GENTLEMEN:

THE CITY OF NORTHGLENN SHARES THE CONCERN OF EPA AND OTHERS REGARDING A PIECEMEAL APPROACH TO ENVIRONMENTAL PLANNING. WE SUPPORT THE CONCEPT OF A REGIONAL ENVIRONMENTAL IMPACT STATEMENT FOR WASTEWATER FACILITIES TO BE CONSTRUCTED OR EXPANDED IN THE DENVER AREA.

WE ARE CONCERNED, HOWEVER, THAT THE OVERVIEW EIS TALKED IN NEGATIVE TERMS WITH RESPECT TO LAND APPLICATION AS A METHOD OF SEWAGE TREATMENT. FOR EXAMPLE, THE ADVERTISING SUPPLEMENT IN THE LOCAL PAPERS NOTED "PUBLIC HEALTH AND SOIL DAMAGE MAY RESULT FROM AGRICULTURAL IRRIGATION WITH WASTEWATER TREATMENT PLANT DISCHARGE UNLESS BETTER TREATMENT QUALITY IS ATTAINED." THERE ARE OTHER NEGATIVE STATEMENTS IN THE MAIN REPORT ON PAGE IV-94, PAGE V-14, V-15 AND PAGE VI-1. ①

SPECIFIC GUIDELINES FOR WASTEWATER QUALITY TO BE USED FOR AGRICULTURAL IRRIGATION ARE SO STRINGENT THAT ADVANCED WASTEWATER TREATMENT (AWT) WOULD BE REQUIRED PRIOR TO LAND APPLICATION. PAGE 25 OF THE SUMMARY EIS AND PAGE V-14 OF THE MAIN REPORT INDICATE, AMONG OTHER THINGS, THAT TOTAL NITROGEN SHOULD NOT EXCEED 5 MG/L AND AMMONIA SHOULD NOT EXCEED 3 MG/L. IF THESE GUIDELINES ARE ALLOWED TO STAND, THE WHOLE IDEA OF LAND APPLICATION AS A METHOD OF WASTEWATER TREATMENT WOULD BE DEALT A SEVERE BLOW.

MR. THOMAS C. JORLING, ASSISTANT EPA ADMINISTRATOR, HAS SAID THAT "MUNICIPAL WASTE IS COMPRISED OF, AMONG OTHER THINGS, PHOSPHOROUS, POTASSIUM

AND NITROGEN. THE STANDARD NUTRIENTS OF COMMERCIAL FERTILIZER. THESE MATERIALS SHOULD HAVE BEEN INCORPORATED INTO A NEW ECOLOGICAL DEFINITION OF SECONDARY TREATMENT. YET THIS WAS NOT DONE AND HAS NOT BEEN DONE." IN A JULY 1, 1977 PRESS RELEASE MR. JORLING FURTHER NOTED THAT MUNICIPAL TREATMENT TECHNOLOGIES HAVE BECOME "HIDEBOUND" AND EPA IS HAVING DIFFICULTY PROMOTING RECYCLING OF SEWAGE WATER FOR IRRIGATION PURPOSES BECAUSE OF INTERNAL "INERTIA" AND RESISTANCE TO CHANGING FROM CONVENTIONAL SEWAGE TREATMENT TO LAND APPLICATION METHODS.

WE AGREE WITH MR. JORLING THAT NUTRIENTS IN SEWAGE MUST BE PUT TO BENEFICIAL USE. WE AGREE WITH THE EIS THAT STANDARDS MUST BE ESTABLISHED FOR AGRICULTURAL REUSE OF SEWAGE EFFLUENT. HOWEVER, THESE STANDARDS MUST BE CONSISTANT WITH THE NATIONAL STATE-OF-THE-ART OF LAND APPLICATION AND MUST RETAIN THE NUTRIENTS VALUABLE TO THE FARMER AND TO HIS LAND.

ANOTHER SPECIFIC COMMENT, THE ENERGY IMPACTS ANALYSIS IS TOO GENERALIZED. ② IT SHOULD CONSIDER CONSTRUCTION AND OPERATION OF THE PLANT, INCLUDING ENERGY IMPACTS OF THE MANUFACTURE OF CHEMICALS AND TRANSPORTATION OF CHEMICALS AND SLUDGES. THE ENERGY SAVED BY APPLYING NUTRIENTS IN THE SEWAGE DIRECTLY TO THE LAND RATHER THAN MANUFACTURING AND DELIVERING PETROLEUM-BASED FERTILIZER IN LIKE QUANTITY SHOULD BE CONSIDERED. ALSO, SPECIFIC OPERATIONAL COMPARISONS BETWEEN CONVENTIONAL TREATMENT PLANTS AND LESS INTENSIVE ALTERNATIVES SUCH AS LAND TREATMENT SHOULD BE CONSIDERED.

THE CITY OF NORTHGLENN HAS PUT TOGETHER A COMPREHENSIVE PLAN FOR TOTAL ③ WATER RESOURCES MANAGEMENT. WHICH INCLUDES A PLAN TO TREAT STORM RUNOFF. BECAUSE STORM RUNOFF, SEWAGE TREATMENT AND WATER SUPPLY WILL ALL BE COMBINED INTO A SINGLE SYSTEM, WE WILL MEET THE 1983/85 GOALS OF PL 92-500 FOR BOTH

POINT AND NON-POINT SOURCE DISCHARGES AT REASONABLE COST. IT WOULD APPEAR THAT OTHER CITIES COULD DO THE SAME THING AND WORK TOWARD REACHING 1983/85 GOALS NOW RATHER THAN JUST MEET 1977 GOALS NOW AND REBUILD OR EXPAND IN 1982 TO MEET 1983/85 GOALS.

THE NORTHGLENN LAND AND WATER RESOURCES MANAGEMENT PROGRAM GOES TO THE HEART OF THE FIVE MAJOR ENVIRONMENTAL IMPACTS AREAS IDENTIFIED IN THE EIS. ④

I. SOCIO-ECONOMIC IMPACTS

THE NORTHGLENN SYSTEM WILL BE CAPABLE OF SERVING THE ULTIMATE POPULATION OF NORTHGLENN; THE SYSTEM IS RELIABLE & WILL PROVIDE A HIGHER LEVEL OF SERVICE THAN THE PRESENT SYSTEM; IT WILL MEET ALL FUTURE WASTEWATER TREATMENT REQUIREMENTS; IT WILL COST LESS THAN THE PRESENT APPROACH WHEN NON-POINT SOURCE DISCHARGE PROBLEMS ARE ADDRESSED. IT WILL PROMOTE PRODUCTIVE EMPLOYMENT IN THE AGRICULTURAL SECTOR WITH RIPPLE EFFECTS THROUGHOUT THE REMAINDER OF THE ECONOMY.

II. WATER QUALITY IMPACTS

THE NORTHGLENN SYSTEM:

- MEETS THE 1983 GOAL OF FISHABLE/SWIMMABLE WATERS AND THE 1985 GOAL OF NO DISCHARGE OF POLLUTANTS
- TREATS STORM RUNOFF WATER
- USES FRONT-RANGE WATER RESOURCES FOR FRONT-RANGE USERS
- CONSERVES WATER RESOURCES AND INCREASES WATER SUPPLY

III. AGRICULTURAL IMPACTS

THE NORTHGLENN SYSTEM:

- PROMOTES A PARTNERSHIP BETWEEN CITY & FARMERS TO PRESERVE AGRICULTURAL WATER RIGHTS AND PRIME IRRIGATED LAND
- PROVIDES FERTILIZER & INCREASED WATER SUPPLIES TO INCREASE FARM PRODUCTIVITY

IV. ENERGY IMPACTS

STUDIES HAVE SHOWN ADVANCED WASTEWATER TREATMENT (AWT) TO BE 5 TO 10 TIMES AS ENERGY INTENSIVE AS LAND TREATMENT. LAND APPLICATION ALSO SAVES ENERGY ASSOCIATED WITH THE PRODUCTION OF PETROLEUM BASED FERTILIZERS AND MAKES THE FARM COMMUNITY LESS SUSCEPTIBLE TO THE NEGATIVE IMPACT OF ENERGY SHORTAGES BY PROVIDING FERTILIZER TO THEIR CROPS.

V. AIR QUALITY

A LAND LOCKED CITY WAS ABLE TO FIND A WAY TO HELP PRESERVE AGRICULTURAL LANDS, THEREBY HELPING TO PREVENT URBAN SPRAWL AND AIR POLLUTION PROBLEMS OF SPRAWL & AUTO TRANSPORT.

IN CONCLUSION, WE DO NOT AGREE WITH MESSRS. HENDRICKS AND BLUESTEIN'S ④ STATEMENT REFERRED TO ON PAGE IV-95 OF THE EIS THAT "IMPROVEMENTS OF WATER QUALITY IN THE PLAINS SOUTH PLATTE TO 1983 LEVELS (AS SPECIFIED BY PL 92-500) WILL RESULT IN FEW BENEFITS AND AT VERY HIGH COSTS." WE ARE JUST BEGINNING TO UNDERSTAND THE PROBLEM, SO TO THROW UP OUR HANDS IN DEFEAT IS INAPPROPRIATE. THE NORTHGLENN PROGRAM COULD BE USED BY MANY OTHER CITIES TO BEGIN TO SOLVE THEIR WATER SUPPLY, SEWAGE TREATMENT AND STORM RUNOFF TREATMENT PROBLEMS. IT WILL TAKE A COOPERATIVE EFFORT BY CITIES, FARMERS, ENVIRONMENTALISTS, ECONOMISTS, CONSERVATIONISTS, ENGINEERS, BIOLOGISTS, POLITICAL SCIENTISTS AND MANY OTHER DISCIPLINES TO CLEAN UP OUR NATION'S WATERS. THIS EIS

SHOULD ENCOURAGE SUCH COOPERATION AND FEDERAL FUNDING SHOULD BE ALLOCATED IN SUCH A WAY AS TO FAVOR COOPERATIVE VENTURES WHICH COMBINE ALL ASPECTS OF WATER RESOURCES MANAGEMENT.

RESPONSES TO COMMENTS BY THE CITY OF NORTHGLENN
18 JULY 1977

1. The guidelines for effluent quality for land application stated in the Draft EIS were in error. There are valid concerns which must be addressed in land application. In some instances, primary treatment may be all that is required as for fodder crops for non-dairy cattle. In other instances, as for non-processed food crops, very high levels of wastewater treatment may be required to avoid contamination with pathogenic organisms. Dissolved salts and heavy metals may cause soil and crop damage and/or require more intense farm management, cultivation and excess irrigation. See discussions in Volume 1, subsections III-3 and IV-3.

2. This is a valid point. Please see discussions in Volume 1, subsections III-8 and IV-8.

3. A valid point, however, please see discussions in Volume 1, subsections III-3, 5 and IV-3, 5.

4. No response required.

Phone
(303)
289-5801

CITY OF THORNTON 8992 N. WASHINGTON ST., THORNTON, COLO. 80229

July 18, 1977

Mr. John A. Green, Regional Administrator
Environmental Protection Agency, Region 8
1860 Lincoln Street, Suite 900
Denver, CO 80203

Dear Mr. Green:

The City of Thornton wishes to thank you for this opportunity to comment on the E.P.A.'s draft environmental impact statement. The City has a number of concerns about this draft; the primary ones will be discussed in this letter.

The City's first major concern is the recommendation that no grants be made in Adams and eastern Boulder Counties. The vast majority of land inside incorporated boundaries of this area has already progressed in the land conversion chain from agricultural to land corporation or investment company ownership. This is a fact that must be dealt with in realistic terms. Lack of federal funding for waste water construction would do little more than increase the already high cost of housing. ①

We appreciate the E.P.A.'s concern for water rights. However, over the years a fairly elaborate and sophisticated structure for dealing with the water right situation within the State Constitution has evolved. To superimpose a federal agency such as the E.P.A. over a State matter such as water rights seems extremely burdonsome. We ask that this matter be left at the State level where it has historically been dealt with in a competent and efficient manner. ②

The City's third area of concern is the draft's discouraging approach toward land waste treatment. The many benefits of these programs should be addressed and amplified in the draft environmental statement. It seems to us that Region VIII's approach to this problem is out of step with the President's mandate concerning land treatment and its priority position concerning funding. ③

"The City of Planned Progress"

Thornton strongly disagrees with the draft environmental impact statement concerning further restrictions on the ability of municipalities to obtain water. We strongly urge reconsideration of this matter. House Bill No. 1555 (1975) already imposes substantial restrictions to the condemnation of water rights. It is our belief that the E.P.A. should consider the practical problem of restricting the City's ability to acquire water rights held in combination with land for speculative purposes. ④

Again, we appreciate this opportunity to participate in the review of the Environmental Protection Agency's draft environmental impact statement. If we can be of any further assistance, please do not hesitate to contact us.

Sincerely,

CITY OF THORNTON, COLORADO

Richard L. Gerstberger

Richard L. Gerstberger, P.E.
Director of Utility Operations

RLG:ls

cc: C. Palmer, Utilities Engineer
J. Perry, City Manager and Utilities Director
file

RESPONSES TO COMMENTS BY
THE CITY OF THORNTON
18 JULY 1977

1. Please see discussions in Volume 1, subsections III-9 and IV-9.

2. Please see discussions in Volume 1, subsections III-6 and IV-6.

3. Please see discussions in Volume 1, subsections III-4 and IV-4, and responses to City of Northglenn's comments immediately preceeding.

4. Please see discussions in Volume 1, subsections III-7 and IV-7.

July 14, 1977

Office of the City Manager

Mr. John A. Green, Regional Administrator
Environmental Protection Agency, Region VIII
1860 Lincoln Street, Suite 900
Denver, Colorado 80203

Dear Mr. Green:

The City of Westminster thanks you for the opportunity to comment on the EPA's draft EIS. The City has a number of concerns about the draft; the primary ones will be addressed in this letter.

① The first major concern is the discouraging approach taken towards land waste treatment. While the quality of effluent used in such projects is indeed a concern, with present technology it hardly deserves the emphasis placed on it in the EIS. Attached for your reference are portions of supporting reports adopted by EPA. The many benefits of these arrangements, including the participating municipalities' stake in maintaining agricultural use on affected land, should be addressed and amplified. With President Carter's suggested mandate that this process receive funding priority, Region VIII's approach seems particularly out of step. It is also paradoxical that this quality issue receives such attention while the fact that 120,000 people are drinking water that receives direct discharge of less than secondary effluent goes unmentioned.

② The second area of concern is the cursory treatment of the plutonium situation. This is an issue that must be addressed and resolved while the possibility of implementing a solution, should one be needed, exists. A Denver Regional EIS which does not begin to address this issue has a serious shortcoming.

③ The City's third area of comment is the recommendation that no grants be made in Adams and eastern Boulder Counties. The practicality of the situation is that the predominance of land inside incorporated boundaries of this area has already progressed in the land conversion chain from agricultural to land corporation or investment company ownership. This is the reality that must be dealt with. Lack of Federal funding for wastewater construction would do little more than increase the already high cost of housing.

④ Westminster urges the draft EIS's statement favoring further restrictions on the ability of municipalities to obtain water to be

(Continued)

3031 West Seventy Sixth Avenue • 80030 • 303 429-1546

reconsidered. House Bill 1555 (1975) already imposes substantial barriers to the condemnation of water rights. The EPA should consider the practical problem of restricting the City's ability to acquire water rights held in combination with land for speculative purposes. Much of the water currently under condemnation is in this category.

EPA's concern with water rights is understandable. However, in the 100 years of Colorado's statehood, a fairly elaborate and sophisticated structure for dealing with the water rights situation under the State Constitution has evolved. To suppose a federal agency, such as EPA, should at the "last minute" require satisfaction with what has for a century been a state matter seems extremely overreaching. We ask that this be left to those who have historically proved competent to deal with the matter. ⑤

Although the EPA did not recommend one of the three wastewater alternatives, the choice seems to be between the no-action and local alternatives. The City of Westminster urges selection of the local alternative for the following reasons: ⑥

1. The no-action alternative would place undue economic hardship on the region's citizens.
2. The area has a good record of meeting water quality goals thus far and is actively striving to meet future goals.
3. Denial of funds for the region based on future growth or urban runoff cannot be justified.
4. The ambitious goals set by PL92-500 go hand in hand with federal funding commitments. Without this the act must be seriously re-examined.

Enclosed are the City's comments on specific items. Please feel free to call us at the City if you need any amplification on our concerns.

Very truly yours,

Steve Garman

Steve Garman
City Manager

cc: Water Quality Control Commission
Denver Regional Council of Governments

CITY OF WESTMINSTER July 14, 1977

TECHNICAL COMMENTS on EPA's DRAFT EIS

Draft Page	Comment	
I-11	A likely decision option occurs at the junction of alternative systems and agricultural land loss.	②
II-24	The statement that new water will come from importations is misleading. This ignores exchange programs based on a change of agricultural rights to municipal use, non-tributary groundwater, developed water, conservation savings and the purchase of water rights. It also ignores the fact that water in the region is not managed to achieve maximum use.	④
II-49	Refer to letter comment.	
II-62	Westminster's current tap fee is $720 for wastewater service. User charges are based on winter water use at $.65 per thousand gallons of average monthly consumption.	⑦
III-3	Westminster and Broomfield have accepted management responsibility for the upper Big Dry Basin as defined by DRCOG. It is generally the land west of I-25.	⑧
III-10	The 201 facility plan is considering expansion to 7.0 MGD for Broomfield and Westminster.	⑨
III-17	The Draft EIS recognizes that the water rights issues involved in various effluent reuse, successive use and exchange plans are too complex and too individualized for it to discuss in any detail. However, the Draft EIS does make several statements about the water rights aspects of such wastewater systems and to those statements the City of Westminster submits this response.	⑤

Initially, it should be noted that the Draft EIS does not consistently use the various terms ("reuse", "successive use", and "exchange") which describe different types of effluent use systems. It may be helpful to note that in *City and County of Denver v. Fulton Irrigating Ditch Co.*, 179 Colo. 47, 506 P. 2d 144 (1972), the Colorado Supreme Court set forth the following definitions as to transmountain (foreign) water:

> "Reuse" means a subsequent use of imported water for the same purpose as the original use. For example, this could embrace the treatment of sewage resulting in potable water which is re-cycled into the regular water system.

(Continued)

Draft Page Comment

> "Successive use" means subsequent use by the water importer for a different purpose. This includes the practice of the City of Aurora and possibly other municipalities which treat sewage containing imported water for further use by the city for irrigation of public parks and facilities and for industrial uses.
>
> "Right of disposition" means the right to sell, lease, exchange or otherwise dispose of effluent containing foreign water after distribution through Denver's water system and collection in its sewer system. (179 Colo. at 52)

Although these definitions are used in regard to foreign water, the EIS may wish to adopt them for general use in its Statement.

The plan contemplated by the contract between Farmers' High Line Canal and Reservoir Co. and Westminster is a water exchange plan. An exchange of water as contemplated by statute (CRS 1973, S37-80-120(2)-(4) and S37-83-101, et seq.) allows municipal use of hitherto agricultural irrigation water and repayment of water to the agricultural water owners from effluent from Westminster's Big Dry Creek Wastewater Treatment Facility. Since under this plan the water will be first used for municipal purposes and the effluent then used for agricultural purposes, it is an exchange plan which is somewhat analogous to what the Court has defined as "successive use", yet also follows the concept of "right of disposition".

The draft EIS fails to adequately describe the concept of a water exchange. It confuses the ability of a water user to reuse, successively use and to dispose of imported water with the ability of a water user to exchange water. Under Colorado law (see CRS 1973 S37-80-120(2)-(4)) a water user may not impair the availability of water lawfully divertible by others. The concept of exchange is not restricted to imported, non-tributary, or developed water but may be exercised as to any water. Therefore, the statements in the draft EIS on p. II-46, III-17, IV-83 and Appendix 22 concerning the restrictive use of water which is not imported omit a significant concept.

IV-15 Although the derivation of the per cent of growth to 2000 accommodated is unclear, 7% for Westminster/Broomfield seems incorrect. Improved treatment is an objective of the facility plan. ⑩

(Continued)

Draft Page	Comment	
IV-28, IV-30	Please check with DRCOG for updated Westminster figures. An explanation of its allocation technique will also clarify why the local and regional numbers seem so far apart.	⑪
IV-34	The conclusion that agricultural demand is less flexible than municipal is wrong. Municipalities have at most a 30 per cent margin of flexibility. Farmers have historically adapted to the natural supply which roughly varies from 40% to 150% of average.	⑫
IV-67	The present Big Dry Plant is discharging 1 MGD or 1.5 cfs. Removal of this flow from Big Dry Creek can hardly be called a significant flow reduction.	⑬
IV-76	Groundwater water supply is a designated use for the South Platte below MDSDD #1.	④
IV-82	See comments on III-17.	⑤
IV-94	Refer to letter comment.	①
V-3	Refer to letter comment.	③
V-15	Refer to letter comment.	①
V-16	Refer to letter comment.	⑤

EPA-660/2-73-006b
August 1973

Environmental Protection Technology Series

Wastewater Treatment And Reuse By Land Application - Volume II

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Office of Research and Development
U.S. Environmental Protection Agency
Washington, D.C. 20460

SECTION IX

LAND APPLICATION POTENTIAL

Many benefits as well as limitations involved in land application have been discussed in this report. In this section the intent is to place both limitations and positive aspects of land application in perspective and to attempt to analyze the future potential of the various methods. The first part of the discussion deals with municipal wastewater; the second part deals with industrial wastewater.

MUNICIPAL WASTEWATER

Land application of municipal wastewater in this country has been done mainly by irrigation, to a lesser extent by infiltration-percolation, and not at all by overland flow. The limitations and benefits of each approach are different and will be discussed separately.

In comparing the three approaches to land application it is helpful to define the objectives to be achieved with treated wastewater and to observe the response of each approach in realizing those objectives. In Table 29 a list of objectives has been assembled and the ability of each approach to realize those objectives is tabulated. As can be seen, each approach has several potentialities as well as limitations. In addition to considerations of management objectives, an analysis of land application must include considerations of the Federal Water Pollution Control Act Amendments of 1972.

Federal Amendments of 1972

Land application was given a substantial role in the Federal Amendments of 1972 to implement the "national goal that discharge of pollutants into navigable waters be eliminated by 1985." Section 201(b) of the Act stipulates that:

> (b) Waste treatment management plans and practices shall provide for the application of

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Table 29. Comparison of Irrigation, Overland Flow, and Infiltration-Percolation for Municipal Wastewater

	Type of approach		
Objective	Irrigation	Overland flow	Infiltration-percolation
Use as a treatment process with a recovery of renovated water	Impractical	50 to 60% recovery	Up to 90% recovery
Use for treatment beyond secondary:			
1. For BOD and suspended solids removal	90-99%	90-99%	90-99%
2. For nitrogen removal	Up to 90%[a]	70-90%	0-80%
3. For phosphorus removal	80-99%	50-60%	70-95%
Use to grow crops for sale	Excellent	Fair	Poor
Use as direct recycle to the land	Complete	Partial	Complete
Use to recharge groundwater	0-30%	0-10%	Up to 90%
Use in cold climates	Fair[b]	--[c]	Excellent

[a] Dependent upon crop uptake.

[b] Conflicting data--woods irrigation acceptable, cropland irrigation marginal.

[c] Insufficient data.

> the best practicable waste treatment technology before any discharge into receiving waters, including reclaiming and recycling of water, and confined disposal of pollutants so they will not migrate to cause water or other environmental pollution and shall provide for consideration of advanced waste treatment techniques.

Land application is emphasized in Section 201(d)(1) by the stipulation that:

> (d) The Administrator shall encourage waste treatment management which results in the construction of revenue producing facilities providing for —
>
> (1) the recycling of potential sewage pollutants through the production of agriculture, silviculture, or aquaculture products, or any combination thereof;

Thus, land application must be considered as an alternative to conventional and advanced wastewater treatment in the prevention of surface water pollution.

Irrigation

The benefits of irrigation are many: economic return on the sale of crops; saving of potable water supplies through exchange by irrigating landscapes, golf courses, parks, and highway medians with wastewater; fire protection by hillside spraying (especially in California [141]); and serving as a positive and reliable alternative to advanced waste treatment and/or surface water discharge. The latter benefit applies to most land application methods.

As shown in Section VIII, economic benefits from the sale of crops have been substantial in some cases. Operating costs are low due to the relative simplicity of operation.

Irrigation with municipal wastewater may be allied with the need for open space and green belts in urban and suburban areas. The Golden Gate Park wastewater reclamation plant in San Francisco, California, has been producing 1 mgd of water for this purpose for the last 40 years [70, 48, 73]. Irrigated lands have also been leased for recreational purposes such as duck hunting in the fall. In Section 201(f) of the 1972 Federal Amendments it is stipulated that "waste treatment management which combines open space and recreational considerations with such management" shall be encouraged.

Several limitations to irrigation have been mentioned in this report. The principal ones are the considerable land area required, its relatively high cost, and its relatively long distance away from large urban sources of wastewater. In climatic Zones A and B in moderate-sized cities near agricultural areas, the practice is quite feasible, and many cities have followed this approach. In climatic Zones C, D, and E the need for irrigation water is less and agricultural land has considerable value without irrigation; therefore, the practice requires other motivations. At Muskegon, Michigan, where nearly 10,000 acres will be irrigated, the need was for an economic and feasible alternative to surface water disposal [34].

Limitations to spray irrigation for health reasons are less severe. Adequately disinfected wastewater should pose no danger to health when it is sprayed. Aerosols for spraying should be kept from traveling as heavy mist outside of the irrigation tract by rows of trees or buffer zones. Any aerosolizing of inadequately disinfected municipal wastewater, be it in an activated sludge plant, a river outfall, or in a spray field, produces some risk to human health, and these risks should all be minimized. Sprinklers that spray downward or horizontally, especially with low nozzle pressure, adequate disinfection, and buffer zones all function to increase the safeguards.

Overland Flow

Overland flow is subject to the same types of limitations as irrigation, but it can be done with a relatively impermeable soil and a gently sloping terrain. These latter two factors may combine to yield a land site of moderate cost. In general, suitable sites will be as difficult to find within economic transmission distances of cities as they are for irrigation.

Overland flow has considerable potential for treatment of municipal wastewater. At Ada, Oklahoma, comminuted municipal wastewater has been sprayed at low pressures in an experimental system at a loading rate of about 4 in./wk. The results show an effluent of a quality approaching that from tertiary treatment. In addition to a relatively low construction cost, the system produces no sludge, which is an aspect with great appeal.

Operating costs are considerably lower than for conventional plus advanced waste treatment because of the relative simplicity of operation. Further research and development of this highly promising approach is required in the area of phosphorus removal, loading rates, and applicability to cold climates.

Overland flow has the advantages of avoiding groundwater degradation, of providing economic return through the growth and sale of hay, and providing a high quality effluent suitable for many additional reuse applications. As indicated in Table 29, it cannot be used as a complete direct recycle of wastewater to the land. However, the runoff will be of high quality and can be directly recycled by any other land application approach.

Infiltration-Percolation

Benefits from infiltration-percolation of municipal wastewater include (1) an economic alternative to surface water discharge, (2) a treatment system with nearly complete recovery of renovated water possible, and (3) a method of repelling salt water intrusion into aquifers. The high rate systems pioneered in the southwest have the further benefit of requiring very little land area.

The major limitations of the process are in connection with groundwater effects. The fact that influent nitrogen is converted to the nitrate form, which is leached to the groundwater, is of major concern. If the groundwater zone becomes anaerobic, conversion of sulfates to hydrogen sulfide may also be a problem.

Nitrates can be a problem (1) if the groundwater is reused for potable supply, (2) if the groundwater is reused for recreation lakes, and (3) if the groundwater is reused for unrestricted irrigation.

These problems are (in the order mentioned) related to (1) causing methemoglobinemia in children, (2) eutrophication, and (3) overstimulation of crops, such as grapes, in which nitrate nitrogen concentrations above 30 mg/L are reported to cause abundant growths of foliage at the expense of fruit production.

At Flushing Meadows, Arizona, research and operational changes have been aimed at increasing the nitrogen removal of their high rate system. Further research needs to be conducted on this subject.

Less critical limitations include the following: (1) phosphorus retention in the soil matrix may be neither complete nor of long duration; (2) suitable soils must be highly permeable yet must contain enough fine particles to ensure adequate renovation; and (3) the groundwater aquifer receiving the water needs to be monitored and controlled for high rate systems to prevent groundwater degradation.

INDUSTRIAL WASTEWATER

The potential use of land application for industrial wastewaters is nearly as great as that for municipal wastewater. In addition to the food processing, pulp and paper, and dairy industries which have utilized land application extensively, such diverse industries as tanneries [91] and chemical plants [140] have used land application successfully. In general, for plants located in rural or semirural areas that produce wastewaters with mainly organic contents, land application offers great potential. For industries producing toxic or high inorganic content wastewaters, land application probably offers small promise. There are so many modifications and combinations of land application methods that could be used for any given industrial wastewater, that no sweeping limitations can be stated solely on the basis of a type of industry.

In general, industries are more able than municipalities to include new technology in their wastewater management plans, which partially explains their use of the overland flow approach. Industries have allowed the soil matrix to provide a greater amount of treatment than have municipalities and have tended to search out the limits of loading for soil systems. With this approach it is likely that new improvements or modifications to the common methods will continue to come from industries as well as from soil scientists and researchers.

RESPONSES TO COMMENTS BY
THE CITY OF WESTMINSTER
14 JULY 1977

1. Please see discussions in Volume 1, subsections III-3 and IV-3; and responses to comments from the City of Northglenn.

2. Please see the material added to Volume 2, Section II (p. 62).

3. Please see discussions in Volume 1, subsections III-9 and IV-9 and comments from the city of Northglenn.

4. Please see discussions in Volume 1, subsections III-7 and IV-7.

5. Please see discussions in Volume 1, subsections III-6 and IV-6.

6. Please see Volume 1. EPA has chosen the local alternative with certain conditions.

7. Corrected and updated information on user charges is presented in Table II-O, p. 73.

8. Unable to find reference to Big Dry Basin on page III-3, Volume 1.

9. This has been updated in Section III, Volume 2 (p. 95). Also see Table III-A information for Lower South Platte, Broomfield/Westminster and Northglenn facilities plans (pp. 88 and 90).

10. Table IV-E has been updated (p. 121). Increased capacity appears to be an equally important objective.

11. Figures for Westminster have been updated on Table IV-H, Section IV, Volume 2 (p. 133).

12. Text has been modified in Section IV, Volume 2 (p. 140).

13. Text has been changed in Section IV, Volume 2 to reflect this comment (p. 179).

JAMES L. OGILVIE
Secretary-Manager

Board of Water Commissioners
144 West Colfax Avenue Denver, Colorado 80202 Phone 222-5511
COMMISSIONERS
CHARLES F. BRANNAN, President JAMES B. KENNEY, JR., 1st Vice-President
WILLIAM G. TEMPLE JOHN A. YELENICK DON FRIEDMAN

July 18, 1977

Mr. John A. Green
Regional Administrator
United States Environmental Protection
Agency Region VIII
1860 Lincoln Street
Denver, Colorado 80203

Dear Mr. Green:

From our review of the Denver Regional Environmental Impact Statement for Wastewater Facilities and the Clean Water Program, we feel the obligation to transmit our comments.

The recent water situation and the increasing awareness of water as a limited natural resource is beginning to influence policy decisions in the current administration. Regional and national offices of EPA are beginning to view successive use of water in a new light. Successive use has already been shown both possible and beneficial in the areas of agriculture and industry. We feel that the potentially beneficial possibility of potable reuse should be evaluated by construction and operation of such a facility on a research basis. It is of national and international interest to determine the actual benefits and/or problems of such an operation. The result could be that potable reuse will present a very timely alternative to local water use planning. ①

Reuse facilities would not only have positive affects on water quality by removal of pollutants, but would reduce the demand and subsequent degredation of the unpolluted waters of the region. ①

The following is an excerpt of the draft Environmental Impact Statement (pp.III-17). "EPA's chief concern is, of course, protection and enhancement of water quality. If any of the potential reuse or land application systems have positive water quality benefits that would result in attainment of relevant stream standards, such systems may be eligible for construction grant funding."

We feel the above paragraph should be modified to specifically afford construction grant funding for successive use plants and to provide for demonstration of potable reuse. ①

②

Regarding the slide show which accompanies the public presentations of the Environmental Impact Statement, we feel it is not correct to say that reuse will reduce stream flow and increase occurance of zero flow conditions and associated problems. The only waters which could be used in a reuse situation are those owned by the user - waters which would not have reached the stream historically. Regulation of this historic flow is governed by Colorado's appropriation doctrine.

Please consider these comments when finalizing the draft Environmental Impact Statement.

Thank you for your consideration in this matter.

Sincerely,

J. L. Ogilvie

J. L. Ogilvie
Manager

JLO:pp

RESPONSES TO COMMENTS BY
THE DENVER BOARD OF WATER COMMISSIONERS
18 JULY 1977

1. Please see discussions in Volume 1, subsections III-3, 6 and 7 and IV-3, 6 and 7.

2. Please see discussions in Volume 1, subsections III-6 and IV-6.

AMES L. OGILVIE
Secretary-Manager

Board of Water Commissioners

144 West Colfax Avenue Denver, Colorado 80202 Phone 222-5511

COMMISSIONERS
CHARLES F. BRANNAN, President JAMES B. KENNEY, JR., 1st Vice-President
WILLIAM G. TEMPLE JOHN A. YELENICK DON FRIEDMAN

August 15, 1977

Mr. John A. Green
Regional Administrator, United States
Environmental Protection Agency
Region VIII
1860 Lincoln Street
Denver, Colorado 80295

Re: Draft Denver Regional Environmental Impact Statement for Water Facilities and the Clean Water Program (DEIS)

Dear Mr. Green:

The purpose of this letter is to supplement my earlier letter dated July 18, 1977 providing comments on the above captioned environmental impact statement. It is our understanding that the Record in this matter is to remain open until the close of business August 15, 1977.

Our earlier comments suggested that potable reuse of secondarily treated waste-water might present a viable future program for local water use planning. Action is needed now to put into early operation a prototype research project with which to study all aspects of the health effects of such a program. Even with such an early start, the lead time to provide the necessary health information upon which a decision on the feasibility of using a large scale potable reuse plant can be made, is so long that developing a large scale operational plant cannot reasonably be expected to occur prior to the 1990's. For that reason, it is critical that action on such a research program occur now so that decisions may be made for the future regarding potable reuse of secondarily treated waste-water. ①

We note that the DEIS utilizes population projections prepared by DRCOG. We concur in your recognition that: a) land use decisions involving population growth are properly the prerogatives of local government; and b) DRCOG's population projections produced as the result of lengthy and coordinated planning at the local level by its member jurisdictions are the best available. For you to use projections other than theirs for your purposes would be to frustrate their extensive effort and it is certain that no other projections could be more accurate; we rely on them ourselves in our water supply planning. ②

We note comments made by those who have no expertise in the water-utility field which argue that the demand for water supply can be substantially reduced by requiring universal metering and utilizing progressive rate structures. It was further argued that these assertions, which are unverified by utility experience, should influence your decision making. ③

The Denver Water Department has studied this subject matter over the last several years and has been unable to discover hard operating facts which support claims that are often made regarding the substantial conservation benefits to be derived from ③ progressive rates and metering. We continue to recognize the necessity for period reviews of the value of requiring universal metering in the older parts of our servic area, however, the Department has yet to conclude that universal metering would provide sufficient benefits when viewed together with the hardships and cost. Furthe the Charter of the City and County of Denver prohibits progressive rate pricing. Wi regard to other comments concerning the value of permanent retention of mandatory restrictions on water use, it is our view that such a program would entail too great mandated change in life style with attendant loss of personal and economic freedom to be acceptable to the customers we serve. In summary, there are no reliable fac available which would require you to alter your basic assumptions concerning wast water treatment plant sizings based on per capita flow generation.

It is hoped these additional comments benefit your review.

Sincerely,

William A. Tolle
Acting for
J. L. Ogilvie
Manager

JLO/ee

RESPONSES TO COMMENTS BY
THE DENVER BOARD OF WATER COMMISSIONERS
15 August 1977

1. Please see discussions in Volume 1, subsections III-3 and IV-3.
2. No response required.
3. Please see discussions in Volume 1, subsections III-7 and IV-7.

DENVER REGIONAL COUNCIL OF GOVERNMENTS
1776 SOUTH JACKSON STREET . DENVER, COLORADO 80210 . 758-5166

July 21, 1977

Mr. John A. Green
Regional Administrator, Region VIII
U. S. Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Dear Mr. Green:

The Denver Regional Council of Governments appreciates the opportunity to comment on the Draft Regional Environmental Impact Statement for Wastewater Facilities and the Clean Water Program prepared by the U. S. Environmental Protection Agency. These comments have been reviewed and approved for transmittal to EPA by the Program Committee of Council.

The DRCOG believes that making an areawide EIS is the appropriate way to ① assess the impacts of multiple wastewater facilities, and that the process will save time and money in the planning, design and construction of facilities. The inclusion of the 208 Clean Water Program in the EIS is also appropriate since all of the proposed wastewater facilities are encompassed by the Clean Water Plan. We believe that, in general, the Draft EIS has successfully related the proposed wastewater facilities to the 208 Plan, and provided information which supports acceptance of the 208 Plan and the construction of all proposed wastewater facilities assessed in the Draft EIS.

The DRCOG supports the major point made by the Draft EIS that if the economic ① advantages of growth are not to be curtailed or eliminated, then public concern about the effects of growth should be directed toward identifying and mitigating potentially deleterious impacts while guiding development toward the attainment of regional land use patterns which are environmentally sound. This is a positive direction as opposed to an arbitrary "no growth" position which would halt construction of wastewater treatment facilities in an attempt to stop population

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growth which in turn would presumably solve the area's environmental problems. The "no growth" position is a specious argument, as we believe the Draft EIS clearly shows. The Council hopes that EPA will recognize this significant conclusion of the EIS and act accordingly in evaluating proposed wastewater and other service facilities. Good planning must consider all factors in community life, not just one or two in an attempt to achieve a narrow or singular objective.

Enclosed are our specific comments on the Draft EIS. Please call on me if we can be of any further assistance in review of the Draft EIS or you have any questions concerning our review and comment on the EIS.

Sincerely,

Robert D. Farley
DLP

Robert D. Farley
Executive Director

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Enclosure

COMMENTS ON THE
DRAFT REGIONAL ENVIRONMENTAL IMPACT STATEMENT FOR WASTEWATER FACILITIES AND THE CLEAN WATER PROGRAM
BY THE
DENVER REGIONAL COUNCIL OF GOVERNMENTS

I. GENERAL COMMENTS

1. The Draft EIS reaches too far in assigning the cause of energy shortages, agricultural land conversion, fog on thoroughfares, suburban migration, mass transit problems, hillside development, mining hazards, wind damage, park vandalism and a number of other environmental impacts to the construction of wastewater facilities. The DRCOG does not believe that a logical cause-effect relationship between these environmental impacts and the construction of wastewater facilities exists. Neither does the DRCOG believe that air pollution problems are caused by wastewater facilities. ②

2. The air pollution problem in the Denver region is largely caused by motor vehicles, and they should be the focus of efforts to reduce air pollution as the EIS properly suggests. Federal vehicle emission standards with an effective vehicle inspection and maintenance program may be adequate mitigating measures as proposed by the EIS. ③

3. It is inappropriate and outside its legislative authority for the Environmental Protection Agency (EPA) to attempt to dictate the form of local government in the Denver region as a prerequisite for federal funding of wastewater facilities. ④

II. MAJOR CONCERNS

1. Failure to Meet 1983 Water Quality Goals

Concern

The 1983 water quality goals will not be met by any of the three proposed wastewater system alternatives. (V1-2)

Comment

⑤ The failure to meet 1983 goals is attributable to urban runoff, about which there is little understanding here or in most of the nation. What is known is that the costs of controlling runoff for water quality reasons will be enormous, and that the federal government has no program to fund such facilities. While some progress in controlling runoff can be made without building structures, some facilities will be needed.

④ Even though urban runoff problems will preclude meeting the 1983 goals, the DRCOG believes that point source wastewater facility controls should be pursued with federal funding assistance. Very substantial improvement in stream quality can be obtained with point source controls and the 1983 goals would be met during much of the year. This is a worthy objective, though perfection may not be attainable because of the non-point source issue.

2. Institutional Requirements for Water Quality Management

Concern

"...there is no assurance that the 208 Plan recommendations will be carried out, given the complex institutional setting of the Denver region. Without such assurance, the long-term value of EPA investments in treatment level and capacity of municipal wastewater treatment plants in the region is open to question." (X-1)

Comment

④ The implication is that the Denver region cannot meet the 1983 goals simply because it has a governmental structure which EPA believes is incapable of achieving that goal. In fact, the Council believes that the "complex institutional setting" has added treatment capacity and levels in recent years sufficient to virtually meet the 1977 interim federal water quality requirements and local agencies are now actively working, in coordination with the DRCOG, to achieve the 1983 goals.

④ The presumption that the form of government must be radically changed in order to meet the 1983 goals is unwarranted. It is inappropriate and outside its legislative authority for EPA to dictate the form of local government in this region. The 1983 goals will be met throughout the nation by a great diversity of local governmental arrangements.

④ The DRCOG has proposed, in the 208 Clean Water Plan, significant changes in how local governments are to relate to one another to achieve the 1983 goals on time while lowering costs, meeting standards and improving the water related environment. These changes are being made with recognition by DRCOG that better decision making mechanisms are needed to further pursue the complex and expensive water quality management programs needed in the next five to six years.

3. Federal Funding of Wastewater Facilities

Concern

The EPA appears to be taking a position that if the 1983 water quality goals cannot be met in this region, continued federal funding assistance for wastewater facility construction would be ineffective in improving water quality.

Comments

This position is not conducive to water quality improvement. It is certainly true that meeting and maintaining water quality goals every day of the year may not happen by 1983 because of runoff problems. However, that does not mean that efforts to achieve the goals should be halted. The region has been progressing in an orderly fashion to meet the goals, and if EPA continues to fund water quality improvement, the goals will be met during most periods of the year with new facilities. ⑥

With federal funding, water quality will be significantly improved, and much earlier than without federal funding. A significant financial burden would be placed on local governments if federal funding of wastewater facilities in the Denver region is terminated and it would take many years beyond 1983 for local governments to finance the needed wastewater facilities on their own. ⑥

4. Local Funding of Wastewater Facilities

Concern

The "No-Action Alternative," i.e. no federal funding assistance for wastewater facilities, may be reasonable because the construction of the facilities will only be delayed about three years, with local governments paying the difference. (IV-70)

Comments

This concern is related to the concern with federal funding. The "No-Action Alternative" is not clearly "no-action" with regard to wastewater facilities improvements. The Alternative is, in fact, ⑥ no more than a no-funding decision by EPA, which is inconsistent with the local and regional wastewater system alternatives. While EPA assumes there will only be a short delay of two or three years if funding for the construction of facilities is denied, in reality, an indefinite delay should be expected since construction would be entirely dependent upon limited local financial resources and a willingness to spend up to four times as much in local funds as would be required for the local and regional wastewater system alternatives.

It seems clear that the federal water quality law was written with ⑥ the assumption that adequate funding would be authorized and appropriated to meet the standards, goals and other requirements of the act. The passage of PL 92-500 on that basis created strong precedent and a moral obligation of the federal government to relate standards to available funding. If the federal government now decides not to fund wastewater facilities, for whatever reason, we believe that the standards, goals and requirements of PL 92-500 should be scaled down accordingly. With all of their other obligations and responsibilities, many local governments will not be financially able to meet the higher water quality standards on their own, and certainly not by 1983.

5. Wastewater Facility/Growth Relationship

Concern

The construction of wastewater facilities alone will encourage growth with accompanying negative environmental impacts.

Comment

The Draft EIS does not attempt to define the environmental "carrying ① capacity" for the Denver Metropolitan Area. The DRCOG adopted year 2000 population forecast of 2.35 million, employment forecast, and regional land use plan are used in the EIS for the evaluation of environmental impacts. The EIS states that as there are few inducements, whether fiscal, economic or legal, resisting pressures for dispersal of economic activity throughout the Region, the DRCOG forecasts of future economic activity and consequent population and land use changes appear valid given all that is known.

The EIS finds that no single municipal service stimulates or con- ① strains regional growth, or can be considered the dominant factor in growth-related environmental impacts, but that the provision of a single service can influence development patterns and the rate of development. Major investment in public facilities supports growth by opening up land for development, and the lack of capacity in any one geographic area may limit growth of that area. From a regional perspective, however, the lack of service capacity in one area often just directs growth to another area. Growth will go where facilities are available to serve it, without affecting the overall growth of the region.

The DRCOG supports the major point made by the Draft EIS that if the economic advantages of growth are not to be curtailed or eliminated, then public concern about the effects of growth should be directed toward identifying and mitigating potentially deleterious impacts while guiding development toward the attainment of regional land use patterns which are environmentally sound. ⑦

6. Wastewater Facility/Air Pollution Relationship

Concern

To what extent does population growth planned for in sewage treatment plant and interceptor capacity relate to further growth in vehicle travel in the metropolitan Denver area and resulting greater air pollution?

Comment

The EPA undertook the EIS with a major objective of defining EPA policy and decision options for assuring consistency between the EPA's Air and Water Programs and the goals of the National Environmental Protection Act. An apparent premise was that stopping the funding, or directing the location, of wastewater facilities would solve the air pollution problem, though it is acknowledged to be largely caused by the automobile. The Draft EIS does not support this thesis, nor does it establish either a direct or indirect relationship between wastewater facilities and air pollution. ②

The relationship of growth and development patterns to air pollution was examined, and the EIS finds that "the results of this analysis indicate that region-wide control of pollutant concentrations is not acheived by a substantial redistribution of emissions...thus, it would not appear to be fruitful to utilize restrictive local land use controls, which might promote development elsewhere, in order to relieve regional air pollution problems." This is a very significant finding with far reaching implications for both air and water quality management as the conclusion is that forcing population and resultant vehicle emissions, by whatever means, to a particular part of the region will not solve the region-wide air pollution problem. DRCOG hopes that EPA will accept this analysis and act accordingly in the ③ evaluation of proposed wastewater facilities. The locations of these facilities are, and will continue to be decided by local governments consistent with the 208 Clean Water Plan, as acknowledged by the U.S. EPA.

7. Air Pollution

Concern

Particulates will be a major air pollution problem in the future, though ozone and carbon monoxide can be reduced to below standards with only occasional "hot spots" or incidents of exceeding standards, through a vehicle inspection and maintenance program. (V1-1)

Comment

The Draft EIS suggests that improvements in automobile engines and an inspection and maintenance program can largely solve the air pollution problem in the Denver region over a period of years. Therefore, the DRCOG does not believe that more drastic air quality control measures are called for, and that, therefore, even if a cause-effect relationship could be proved, the air pollution problem would not be sufficient cause to stop federal funding of wastewater facilities. ③

8. Wastewater Facility/Agricultural Land Use Relationship

Concern

"The region will continue to grow in both population and urbanized areas at the expense of existing and potential agricultural areas." (V1-1)

Comment

The projected growth and development of the region is presumed to result in the loss of "prime agricultural land." How much of the previous loss of land in agricultural production was prime farmland is not known nor can the future loss be projected with any certainty. Difficulties in measuring this problem are admitted by EPA and have not been resolved by the EIS. It is believed by DRCOG that the actual extent of important farmlands, that is, lands with an adequate irrigation water supply and prime agricultural soils, within the projected area of urbanization is actually much less than that indicated by the EIS. ⑦

The relationship between expanded wastewater facilities and the loss of important farmlands has not been demonstrated, and the socio-economic impacts which are projected in the EIS cannot, therefore, be attributed to wastewater facility construction. The EIS states that irrigation water supply, not land, is the real issue, but the extent of the probable loss in irrigation water supply is not quantified, nor is its relative importance in meeting future municipal supply requirements demonstrated. ②

The EIS suggests that the conversion of prime agricultural lands in Adams and Eastern Boulder Counties might be mitigated by not providing federal funds for expanding wastewater treatment facilities. The DRCOG agrees with EPA that the effectiveness of such a measure would be limited since growth is supported by other urban services besides wastewater treatment facilities, and the measure would require carefully coordinated policy support by federal, state and local governmental agencies, an unlikely event in the foreseeable future. ④

dlv
07-13-77

RESPONSES TO COMMENTS BY THE DENVER REGIONAL COUNCIL OF GOVERNMENTS

21 JULY 1977

1. No response required.

2. Please see the Introduction to Section V, Volume 2 and response 3.

3. Please see discussions in Volume 1, subsections III-1 and IV-1.

4. Please see discussions in Volume 1, subsections III-4 and IV-4.

5. Please see discussions in Volume 1, subsections III-5 and IV-5.

6. EPA generally agrees with this comment and proposes to fund additional wastewater treatment facilities. General conditions and policies are explained in Volume 1 and specifically subsections III-3 and IV-3.

7. Please see discussions in Volume 1, subsections III-9 and IV-9.

Lakewood Board of Water and Sewer Commissioners

7801 West Sixteenth Avenue
Lakewood, Colorado 80215
Phone 233-6930

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August 9, 1977

Mr. John A. Green
Regional Administrator
U. S. Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Re: Denver Regional Environmental Impact Statement
for Wastewater Facilities and the Clean Water Program

Dear Mr. Green:

The following is submitted as our comments with respect to the above environmental impact statement.

The difficulty with responding to this environmental impact statement is the difficulty in knowing what the environmental statement addresses. The actions under consideration in the environmental impact statement are actions contemplated with respect to waste water treatment systems under Sections 208 and 201 of the Federal Water Pollution Control Act, Public Law 92-500. Despite this, however, the EPA suggests that one of the purposes of the EIS is to discuss the entire environment of the Denver region considering the Housing and Urban Development [HUD] EIS on the FHA housing program and the Bureau of Land Management [BLM] EIS on the Foothills Water Treatment Plant. Neither of those proposed environmental impact statements has yet been issued, and both will necessarily be concerned with the overall question of population expansion and urban growth and the attitude toward growth that either or both of those environmental impact statements will require consideration of availability of sewage treatment. ①

What makes this particular environmental impact statement confusing is, as this study points out, some construction of sewage treatment capacity is already necessary in order to meet the FWPCA requirements, and the construction of additional capacity will not cause growth. Why then when two other agencies are preparing environmental impact statements which may have an effect on growth is it necessary for this EIS to so thoroughly discuss the question? How can it be ① accurately said that the water treatment facilities produce irreversible and irretrievable commitments of resources by conversion of prime agricultural lands to urbanization by commitment of inadequate supplies of natural gas upon which residential, commercial and industrial sectors are dependent and by increased commitment of available water to urban uses in an area of a nation concerned by limited water resources? These are not commitments of resources which result from the actions being considered by the EIS, but rather are commitments of resources resulting from growth. Since this EIS was issued prior to the proposed HUD and BLM studies, it appears that its true and improper intent and purpose is to enable its use in a regulatory fashion to influence other studies which more directly relate to growth. In this as well as in any other environmental impact statement directed at units of local government, we are concerned that the EIS might be used as a substitute for the judgment of locally elected,publicly responsive officials.As a regulatory document it may be used as a veto, whereby private special interest groups, neither influential nor numerous enough to alter the decisions of local officials, may be used to influence those officials who are not responsive to the local political processes.

If growth is to be considered as a result of the actions being considered within the EIS, the result which should be considered is the effect of federal action which might restrain growth. Surprising, however, no mention in the report is made of the local effect of the failure to increase population or provide for urban growth. Rather, the study suggests that growth will continue to occur despite any action which might be taken under the EIS. ①

Bearing in mind that the purpose of an environmental impact statement under the National Environmental Policy Act is to study the impact of significant federal action on the quality of human environment, and in that context this environmental impact statement ignores some of the most important human environmental impacts which are social, political and economic. ①

The most objectional feature of this environmental impact statement, therefore, is that its study and conclusions far exceed its expressed scope. As a final general comment, it is sad that the authors of the ① statement have punctuated the comments with carefully chosen words expressing their own attitude rather than through direct statements.

SPECIFIC COMMENTS.

The summary, page 11, editorially suggests that the City and County of Denver has decayed and the rich have moved to the suburbs. Examination of the extensive and expensive development in the downtown Denver area does not justify this statement. Furthermore, the post war growth of the suburban area occurred principally, because affordable housing was not available within the city, and while that housing may be newer, the majority of the affluent and advantaged probably still remain inside the City and County of Denver. ②

Eastern Colorado is and has always been so arid that whatever prime agricultural land exists exists solely because of the availability of water. Probably most any farmland anywhere in Eastern Colorado would be made prime agricultural land by the application of irrigation of water. Consequently,prime agricultural land would not be withdrawn as a result of growth, so long as water was made available in another area. ③

Furthermore, whether the prime agricultural land ought to be maintained as such ignores fundamental principles of the Colorado Constitution relating to water law as well as basic principles of hydrology. Colorado has always recognized that water was a limited resource and demand has virtually always exceeded its supply. That recognition led to the customary law of Colorado and the priority system which antedates even the state constitution, and this priority system and the propriety of the water rights doctrine has been acknowledged by the United States Supreme Court in a number of cases. ④

In addition to the general priority system, the Colorado Constitution has also recognized for more than 100 years which uses of water are to be preferred. Those using water for domestic purposes shall have the first preference. Those using water for agricultural purposes shall have the second preference. Those using water for manufacturing purposes shall have the third preference. ⑤

It has also been generally recognized that urban and agricultural development of the eastern slope has increased the total amount of water available and has made possible minimum stream flows in what had formerly been intermittent streams. Water resources studies have shown that precipitation runoffs in a plains area range from 1/4" to 1" per year; whereas, precipitation runoffs from the mountainous areas of the western slope range from 10" to 20" per year. By storing the winter runoff for level release into the sewage system during the year, minimum stream flows have been maintained. Further, the application of irrigation waters to farmland with the subsequent migration of the water back to the stream has had the effect of storage of even agricultural water and increased the potential season for agricultural use. ⑥

It is also generally recognized that actual consumption of water when used for domestic and municipal purposes is only in the order of 10% to 15% of the water diverted, that is for each 7 gallons of water diverted, only 1 gallon is used. In agricultural applications, 1 gallon of water is consumed for each 2 gallons diverted. However, since recreational purposes, as well as minimum stream flows, require that no diversion occur, the actual consumption of water for those purposes requires that 1 gallon of use can only be supported by 1 gallon of diversion. ⑦

It would appear from the relative consumptive uses that urban development is preferable that urban development occur upstream of agricultural development, because a smaller percentage of agricultural water is returned to the stream. ⑦

With respect to park and recreation sites, most municipal authorities have undertaken a program to provide park and recreation facilities for a future rather than present population. Intensified use is, therefore, already contemplated, and in fact if use were not to be intensified, the maintenance expense and devotion of water resources to maintenance of those facilities would be an uneconomical burden on the area. ③

In addition, since these park and recreation facilities are principally for summertime use and are economically developable for year round use, they are not especially efficient. The ③ extensive mountainous area of Colorado offers not only summertime recreational opportunities as well as wintertime recreational opportunities, but much of that land is not so conveniently developable and is consequently much more efficient for recreation. There is certainly no shortage of outdoor recreational areas, nor considering the municipal programs already underway does it appear that intensified use as a result of growth would adversely affect available facilities to a degree not contemplated by local authorities.

The suggestion that Colorado water right laws should be amended ⑥
ignores not only that they are a fundamental part of the organic laws, but also ignores the property rights aspects, subject to other federal and state constitutional limitations with respect to depriving the people who depend on these municipal sources of significant substantial property rights without compensation or due process of law.

An adequate environmental impact statement for this subject would ①
be substantially more limited than the draft and would more seriously be concerned with the adverse environmental effects of negative actions which might be taken within the scope of the report.

Sincerely,

C. W. Reitler, Chairman

RESPONSES TO COMMENTS BY
THE LAKEWOOD BOARD OF WATER AND SEWER COMMISSIONERS
9 AUGUST 1977

1. Please see the Introduction to Section V, Volume 2.

2. It has been noted under "Population" in Section II, Volume 2, that some cursory indicators point to a slowing of the "white flight" to suburbia, with white families moving back to the city center (p. 69).

3. Please see discussions in Volume 1, subsections III-9 and IV-9.

4. Please see discussions in Volume 1, subsections III-9 and IV-9, and III-6 and IV-6.

5. No comment required.

6. Please see discussions in Volume 1, subsections III-6 and IV-6.

7. Please see discussions in Volume 1, subsections III-6 and IV-6, and III-7 and IV-7.

Statement Concerning the
Denver Regional Environmental Impact Statement
for Wastewater Facilities and the Clean Water Program
by William E. Korbitz, Manager
Metropolitan Denver Sewage Disposal District No. 1
July 18, 1977

Several general comments would appear to be in order before comments on specific portions of the Environmental Impact Statement and Summary are offered.

Four areas of general comments are as follows:

1. According to the Environmental Impact Statement findings, an air pollution problem will be present in the metropolitan Denver area in the future and will intensify or be alleviated without any impact by or to the wastewater facilities covered by this Environmental Impact Statement; ①

2. A number of areas of contradiction exist in and between the Environmental Impact Statement and the Summary, especially concerning the degree of treatment of urban wastewaters and the quality of the South Platte River and other streams in the metropolitan Denver area; ②

3. It is gratifying to see in the Environmental Impact Statement a realization that even with tremendously high levels of treatment of the Metropolitan Denver Sewage Disposal District wastewaters and other urban wastewaters in the metropolitan Denver area, the 1983 goals of fishable and swimmable waters will not be achieved. It should follow that reasonable treatment levels will thus be required of the metropolitan Denver area wastewater agencies; ③

4. It is also gratifying to see a realization in the Environmental Impact Statement that non-point sources of pollution rather than point sources of pollution are the real problem in attempting to achieve the 1983 goals of fishable and swimmable waters, and also that the cost of both point source and non-point source treatment would be much out of proportion to the minor improvements in water quality which could be expected from such treatment. ④

The first of the comments about specific parts of the Environmental Impact ⑤ Statement and the Summary deal with the excessive detailed discussions concerning air quality and pollutants in the metropolitan Denver area now and in the future. The findings of the environmental assessment work together with logic indicate that there is no relationship between air quality and wastewater treatment facilities. The many pages dealing with air quality and air quality improvement would thus be better placed in an environmental impact statement or study concerning air quality improvement. It should be obvious that land use control rather than refusal to approve construction of wastewater treatment facilities should be utilized to minimize land development in the metropolitan Denver area.

On page II-43 of the Environmental Impact Statement is a statement "However, even if the Metropolitan Denver Sewage Disposal District No. 1 plant discharged pure water, recommended levels of water quality in the South Platte would still be routinely exceeded". Such a finding should be followed by ⑥ regulatory agencies and the EPA Construction Grants Office in establishing realistic levels of treatment for the Metropolitan Denver Sewage Disposal District No. 1 as well as other wastewater treatment agencies in the metropolitan Denver area.

The energy shortfalls mentioned on page 17 of the Summary and in other places, should encourage increased efforts for development of the proposed Metropolitan Denver Sewage Disposal District No. 1 sludge drying basin project to conserve fertilizer and the resources required to produce fertilizer ⑦

On page 14 of the Summary in the last paragraph is an error in the statement that "About 6.5 million gallons a year, of the Metro discharge is diverted to the Burlington Ditch". The quantity should be 6.5 billion gallons per year rather than 6.5 million gallons per year. ⑧

On page II-62 in the first full paragraph, is a statement concerning income to the Metro Denver Sewage Disposal District being based on charges to "other District". This statement should be revised to indicate that the income is based on charges to cities and sanitary districts which are members of the Metro District. ⑨

A statement on page II-67 of the Environmental Impact Statement would lead the reader to believe that the loss of agricultural land or water supply to urban uses may result in a decline in agricultural output. This is in the first paragraph on the cited page. The urban use of water is less ⑩ than five percent of the state water, and the urban use of land likewise is extremely small compared to agricultural use. There certainly is serious doubt that the urban use of land or water in the foreseeable future would have any significant effect whatever on agriculture. It should be obvious that major water conservation in the urban area would have virtually no impact on the amount of water available in the state of Colorado. On the other hand, even a 10 or 20 percent decrease in agricultural water waste would amount in total quantity to much more than the total amount of water presently used in urban areas of the state.

On page III-2 of the Environmental Impact Statement are the statements "The 208 Plan has estimated that non-point source control, which would result ⑪ in the achievement of the 1983 goals, would cost the area approximately $255,000,000 per year amortized over the 20 year planning period. The conclusion of the 208 study is that this cost is excessive for the "minor" improvement in water quality that would be expected." This should make it clear that the 1983 goals and stream classifications must be made to be realistic, namely for agricultural use and not for fishing or swimming.

On page III-11 in the section on expansion of the Metropolitan Denver ② Sewage Disposal District No. 1 Central Treatment Plant is a statement that "ammonia removal facilities will have to be added to this plant by 1983 in order to meet effluent standards at that time". This is not consistent with statements on page II-43 and page III-2 of the Environmental Impact Statement which indicate that even with pure water from the Metropolitan

Denver Sewage Disposal District No. 1 Central Treatment Plant and adequate non-point source treatment the stream quality of the South Platte River would still not meet 1983 goals. Standards of treatment and stream classifications must be changed to reflect realistic qualities in the South Platte River and other streams. In addition, Table III-13 on page III-12, shows a recommended ammonia level for the Metropolitan Denver Sewage Disposal District No. 1 Central Treatment Plant of 18 milligrams per liter which indicates no ammonia removal. The same table indicates a recommended 20 milligrams per liter of BOD which according to realistic South Platte River stream quality would also not be a necessary level of treatment.

On page 15 of the Summary in the first paragraph the final two sentences ⑧ would mislead the reader concerning the use of wastewater treatment plant discharges for agricultural irrigation. Such wastewater treatment plant discharges have been used for many years for irrigation purposes in the form of water taken from rivers such as the South Platte River which during irrigation season are largely composed of wastewater treatment plant discharges. The terms "unrestricted use" and "under certain circumstances" probably eliminate any realistic meaning from these sentences, thus perhaps the sentences should be omitted.

Page 22 of the Summary includes a section on establishment of a formal ⑫ environmental review procedure. It is suggested that such a procedure would merely add more delay and red tape which would interfere with planning construction and operation of wastewater facilities unless the requirements of the National Environmental Policy Act of 1969 would be eliminated. The one overabundant factor in wastewater facilities planning, construction and operation today is red tape with resulting delays. We do not need more.

The section on acceleration of development of parks and recreation sites ⑬ at the bottom of page 23 of the Summary probably should include concern about the large quantity of water which would normally be required for maintenance of recreational and park sites, especially with water shortage problems facing the people of the metropolitan Denver area.

The first paragraph on page 24 of the Summary improperly would lead the ⑬ reader to believe that growth in the north and northeastern portions of the Denver region would be drastically affected by eliminating grant funds for expansions of wastewater treatment facilities in these areas. Land use regulation certainly would be a more effective measure to discourage growth in these areas if such growth discouragement would be proper.

The section on mitigation of water quality impacts on page 24 of the ⑥ Summary should lead to the obvious conclusion that the 1983 goals as well as other standards and stream classifications should be realistically revised together with discharge permit requirements.

In the first full paragraph on page 25 of the Summary, mention is made ④ again of the conclusion that an effective non-point source control program would be necessary to meet year round water quality goals. It is suggested that extensive study be undertaken to determine actual sources of certain pollutants in the South Platte River rather than assuming that certain pollutants come primarily from Metro Denver Sewage Disposal District No. 1 treatment facilities.

The information contained in the last paragraph on page 25 of the Summary ④ should indicate the need for establishing realistic stream classifications, water quality standards and discharge permit conditions inasmuch as non-point sources of pollutants would apparently be reduced by only 30 percent by non-structural methods as compared to 60 to 75 percent reductions being required. With structural methods being too costly, and non-structural methods ineffective, the conclusions are obvious.

The regional monitoring system mentioned on page 27 of the Summary should ④ be instituted, and could be based on the monitoring system already established by the Metropolitan Denver Sewage Disposal District No. 1.

The air pollution emission sections on pages 28, 29, 30 and 31 of the Summary ⑥ and in several sections of the Environmental Impact Statement perhaps are not properly included in a water quality environmental impact statement, but rather in a study or environmental impact statement concerning air pollution only.

As a part of the section on mitigation of agricultural impacts on pages 31 and 32 of the Summary, it is suggested that a need exists for improved ④ controls over agricultural discharges to waterways.

In connection with the energy conservation and energy use sections on pages 33 and 34 of the Summary, it is again suggested that EPA do everything ⑦ possible to expedite the Metropolitan Denver Sewage Disposal District No. 1 sludge drying basin project and to encourage the use of sludge for fertilizer and to encourage the use of methane gas from anaerobic digestion of sludge.

⑭ The stated major unavoidable adverse impacts included on page 35 of the Summary include several which are misleading or not properly included within the wastewater treatment and clean water environmental impact statement. The adverse impact No. 4 as stated would lead people to believe that strict effluent quality standards would avoid public health or soil damage impacts which could occur as a consequence of agricultural irrigation with wastewater treatment plant effluent. No such impacts have been realized during the many decades during which such treatment plant effluent has been used for agicultural irrigation in Colorado.

⑥ The adverse impacts No.'s 5 and 6 on page 35 of the Summary deal with air pollution which is in no way related to the regional wastewater treatment facilities and clean water environmental impact statement, and should be omitted from this document.

⑥ The adverse impact No. 7 on page 35 of the Summary should be stressed in such a way as to bring about revision of the 1983 clean water goals, stream classifications, effluent standards and discharge permit conditions.

⑫ On page 37 of the Summary the first paragraph indicates a complete mistrust of local government, an attitude which is completely inaccurate, improper and unfounded. There is no reason for the feeling that because many local agencies are involved in implementing a Regional Wastewater Management Plan there would be any less likelihood of its success than if a single agency on the federal, state or local level would be handling the management responsibilities.

On pages 37 and 38 of the Summary are additional statements concerning air quality issues which must be resolved. It is again suggested that no significant relationship exists between the specific air quality discussions and the wastewater treatment and clean water program environmental impact ⑤ statement. A single statement putting the air quality and water quality matters in proper perspective would suffice in these documents.

It is suggested that on the basis of the Environmental Impact Statement ⑥ and Draft Summary of the Environmental Impact Statement for wastewater facilities and the clean water program in the Denver region, the findings that are set forth in these documents be used to amend the 1983 clean water goals, amend the stream classification and effluent standards of the state of Colorado and also the discharge permits of agencies discharging wastewater treatment plant effluent into the waterways of the state. It is encouraging to find that this EPA environmental impact statement recognizes the need to set reasonable levels of treatment of urban wastewaters as well as the realization that there is a definite need to control the quality of rural and urban non-point sources of pollution before the costs of additional point source treatment are forced upon the people of the urban areas.

WEK/j

7/15/77

RESPONSES TO COMMENTS BY
THE METROPOLITAN DENVER SEWAGE DISPOSAL DISTRICT NUMBER 1
18 JULY 1977

1. Please see discussions in Volume 1, subsections III-1 and IV-1.
2. Please see discussions in Volume 1, subsections III-2 and IV-2, and III-3 and IV-3.
3. Please see discussions in Volume 1, subsections III-5 and IV-5, and III-3 and IV-3.
4. Please see discussions in Volume 1, subsections III-5 and IV-5.
5. Please see the Introduction to Section 5, Volume 2.
6. Please see discussions in Volume 1, subsections III-2 and IV-2.
7. Please see discussions in Volume 1, subsections III-8 and IV-8.
8. This point is acknowledged. No changes have been made to the draft summary, however, because there will be no separate summary volume for the final EIS.
9. Corrected and updated information on user charges is presented in Table II-0, p. 73.
10. Please see discussions in Volume 1, subsections III-7 and IV-7, and III-9 and IV-9.
11. Please see discussions in Volume 1, subsections III-2 and IV-2, and III-5 and IV-5, and revise Section III of Volume 2.
12. Please see discussions in Volume 1, subsections III-4 and IV-4.
13. Please see discussions in Volume 1, subsections III-9 and IV-9.
14. Please see the Land Waste Treatment discussions under Direct Environmental Impacts in Section IV, Volume 2 (pp. 193-198).

REGION XII

North West Colorado Council Of Governments

Holiday Center Building - Suite 200
P. O. BOX 739
FRISCO, COLORADO 80443
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23A

GLE COUNTY
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MMIT COUNTY
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RECKENRIDGE
LLON
RISCO
LVERTHORNE

19560

August 3, 1977

Mr. Allen Merson
Environmental Protection Agency
1860 Lincoln
Denver, Colorado 80203

RE: Denver Overview EIS

Dear Mr. Merson:

The Northwest Colorado Council of Governments is vitally concerned with actions taken by EPA and the state on proposed wastewater treatment facilities and implementation of the Clean Water Program as developed by D.R.C.O.G.

① While this region is not downstream or downwind from the Denver Region, plans for action or inaction vitally concern us. This region is the principle raw water supply reserve for the Denver Region, and thus has a vital interest in plans that indicate additional needs for transbasin diversions. The net effect of additional transbasin diversions is to decrease available high quality water that has been used for dilution of natural or man-induced pollution. Since we do not question the legal right to divert, we intend to pursue the environmental, social, and economic ramifications of transbasin diversions and the potential difficulty of maintaining the high quality of water in the region. Of particular concern is the extra regional policies and actions that may impact or impair our ability to meet our water quality goals. We do feel that there is a clear linkage between water quality and water quantity and believe that both the state of Colorado and EPA should consciously consider the impacts of external influence created by decisions in the Denver Region prior to making determinations for water quality management.

② In another sense we are also "downstream" of Denver because of the precedents set by the decision making process for water quality management at the State and Federal level. Establishing minimum levels of performance for water quality management programs is effectively accomplished more by precedent than by decree. Precedents established for "front rante" communities

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appear to be in the making through acceptance of plans which do not meet aquatic life standards and fail to link the actions of land use management agencies to wastewater management agencies in any constructive sense. We thus feel that a "dual standard" has been developing at the State and Federal level and is manisfested in many of the actions of EPA and the State. We do not believe that a dual standard for east slope and west slope, either written or implied, can be effectively administered on an equitable basis under current institutional arrangements available within Colorado.

Water Quantity Relationships

The issues of water conservation, agricultural re-use of wastewater, domestic water re-use, population projections and conversion of agricultural land in the Denver Region all have implications outside of Denver, and specifically within Region 12 and the Colorado River Basin Each of these issues relate directly to how much water will actually be diverted from Region 12 to supply the Denver Metropolitan Area with municipal water. ①

Water is presently diverted from the Eagle River Sub-Basin, Blue River Sub-Basin, Williams Fork Sub-Basin, Fraser Sub-Basin, and the upper Colorado River Basin to supply municipalities within the Denver Region. According to figures developed by the Bureau of Reclamation, an increase of 1 mg/l in TDS at the international border on the Colorado River can be equated to at least $230,000 in annual damages to users within the Colorado River Basin. On an average basis, salinity in the Colorado River will increase 1 mg/l for every 22,500 acre-feet of water diverted from the basin. This can also be translated to an annual cost of $10.22/A-F diverted or a present worth of $205 per A-F diverted. ①

According to the 208 Clean Water Plan, water supply systems in the Denver Region must be increased from their current capacities of 250,000 A-F/yr. to 470,000 A-F/yr. There are only two basic options for achieving this expansion of supply to customers: ①

1. Develop new supplies.
2. Re-use and conserve existing supplies.

Developing new supplies is practically limited to developing transbasin diversion facilities and conversion of agricultural water. Re-use and conservation options include metering, pricing strategies, urban irrigation re-use, agricultural re-use, and exchange and potable water re-use

The most expensive of these options is potable water re-use at ③ approximately $3,500/A-F of water produced at the end of the study period. Figure 7-8 of the Denver 208 Plan seems to indicate that it is presently far more cost effective to develop new water supplies than it is to re-use water. However, it is later stated, page 7-27, that the cost of producing transbasin water is estimated as high as $2,700/A-F. These costs do not ④ include external costs to users in the Colorado River Basin such as the costs of increased salinity ($205/A-F diverted) and other environmental costs which are far more difficult to quantify but just as real in effect including:

1. Higher wastewater treatment costs in Region 12 due to protection of water supplies service charges for wastewater treatment in Region 12 range as high as $40/month compared with Denver's charge of $4/month.
2. Increased treatment costs due to failure to maintain historic minimum stream flows.
3. Loss of aquatic habitats due to diversions.
4. Loss of recreational uses due to diversions.
5. Failure to meet water quality goals in the Colorado Basin.

We can thus conclude that re-use and conservation options ⑤ are much closer to being cost competitive when the full range of costs to the environment is considered.

We believe these issues are statewide in importance and must be dealt with responsibly in a statewide basis. ⑤ The implications of not dealing with the quality aspects of water resource development vs. water conservation and re-use are obvious:

1. Developing new raw water supplies will continue to appear more economical to east slope communities than re-use and conservation because the true costs of transbasin diversions have been externalized (i.e. costs are born by Colorado River water users and residents).
2. Failure to require conservation and re-use options will result in depleted streamflows in the Colorado River Basin.
3. Failure to meet historic minimum streamflows upon which the State bases its discharge permits will not allow Region's 12 streams to maintain the water quality goals.
4. A program to compensate for the lack of minimum streamflows will require still more advanced wastewater treatment plants and even more strict controls for non-point sources than currently envisioned.

5. The end result is that current inequities in the costs of providing for clean water in the Colorado River Basin vs. the South Platte Basin will be even more exaggerated, while even the best efforts of local governments to attain water quality goals will fall short of the mark in Region 12.

Precedents Established

The second factor which links Region 12 to actions taken in the Denver Region is in setting precedents for the level of performance required by water quality and environmental management programs. It appears that the state and EPA are evaluating each facility and 208 Plan based on economic considerations for that area alone, without considering the question of equity throughout the State. It is unlikely that local governments within Region 12 will continue to commit a large proportion of their resources to maintaining clean water unless they see a similar level of commitment throughtout the State. Denver would be the most visible example of the failure to meet the 1983 goals because of its population concentration and location of State government offices. The most frequently asked question in Region 12 is not whether our streams can or should be protected, but rather "what is Denver doing to solve its problems?" This is a basic form of "finger pointing" but has historically been a key reason cited for the failure to meet water quality goals, nationwide. The Federal Water Pollution Control Act Amendments were intended to overcome this mentality by establishing a national goal of fishable swimmable streams in addition to a minimum level of treatment for all pollution sources. ⑤

In reading the Denver Overview EIS, there are more apparant similarities in the environmental management problems than one might expect in two such diverse areas as Region 12 and the Denver Region. The major similarity is evidenced by the fact that non-point sources overshadow point sources as a cause of water quality degradation. A second similarity is that there are relatively major efforts currently under way through the EPA construction grant program to solve the point source problem, while the non-point source control problem remains relatively unregulated with only a small percentage of State and Federal pollution control funds committed towards the solution of the problem. A third similarity is that the expansion of wastewater treatment facilities accomodates growth, thereby increasing the relative magnitude and distribution of non-point source control problems. ⑥

Yet, with all these similarities, we have seen remarkably different approaches at the State and Federal levels towards the solutions to these problems. In Region 12, EPA has determined that where the above situation exists, Federal participation in the construction grant program must be suspended until the ③ appropriate local land use agencies (not sanitation districts applying for the federal assistance) establish strict land use regulations which will control non-point source runoff. In the Denver Region, no such actions have been taken and the construction grant program continues to refine the degree of treatment provided by municipal wastewater facilities while failing to link non-point source control requirements to the grant program. Which approach is correct is certainly a matter of debate. However, it is certainly safe to imply that inconsistent treatment of similar situations has been the case to date.

④ The D.R.C.O.G. 208 Clean Water Plan provides some of the answers to existing non-point source pollution. However, the plan does little to avoid the spread of non-point source pollution in the future despite a projected 45% increase in the amount of developed residential land in the next 20 year period. Controls for new development are very general in nature and do not appear to be designed for implementation through local land use regulatory programs. Within Region 12, we have made substantial negotiations on the behalf of local governments with the State and EPA, maintaining that development of non-point source land use controls for new development through the 208 Program is sufficient to allow the construction grant program to proceed unencumbered. This was not considered by EPA as sufficient assurance that land use controls for non-point sources would be implemented and special conditions have been added to Step II Grants to require these actions from local governments. Again, we feel that a "dual standard" of performance is emerging from the State and EPA with regard to control of non-point sources in two areas which appear to have similar problems.

⑦ Examples of this type also emerge in the handling of air quality related to development and wastewater facilities. Where air quality standards are expected to be violated in Region 12 due to secondary growth impacts of wastewater treatment facilities, a position very similar to the one on non-point sources has been taken. We know of no such actions regarding air quality relationships in the Denver Region.

⑤ The adoption of the D.R.C.O.G. Clean Water Plan as proposed and expansion of wastewater treatment facilities without such special conditions as required in Region 12 raises severe questions concerning the level of equity which can be expected between rural and urban regions of the State and Nation.

Summary and Recommendations

The Northwest Colorado Council of Governments finds that there are definite physical and social ties between water quality management in the Denver Region and management of water resources and water quality in Region 12. We also find that policies which appear to be emerging at the State and Federal levels require inequitable levels of performance from urban and rural areas of the state.

In order to minimize the effects of Water Quality Management Programs in the Denver Region on users of Colorado River water and to minimize the degree of inequity, we recommend the following actions to be taken by the State and EPA:

1. A broader view should be established at the State and Federal levels regarding water conservation, re-use. land application, and other options for reducing imported raw water supplies as they apply to wastewater treatment and water quality management. Cost effectiveness guidelines allow decisions to be made on these options without including the full cost of the entire water system (i.e. costs of transbasin diversions to Colorado River water users). ⑧

2. Because of the direct relationship of water development and re-use options in the Denver Area to the water quality in Region 12, the State and EPA establish regulatory or other control mechanisms which: ⑧

    a. Provides information on the costs of alternative treatment methods on a total system basis, including wastewater treatment, water supply systems, and costs to the environment (including water quality impacts and costs on Colorado River).

    b. Encourages the options of water conservation, potable water re-use, and agricultural water re-use. Incentives could include priority bonus points, and federal participation in grant programs.

    c. Internalizes the costs of existing and proposed transbasin diversions which are now born by users of Colorado River water as opposed to the entity which causes the problem.

    d. Provides disincentives for those entities which do not exercise water conservation or re-use options where the total costs (both economic and environmental) of traditional systems exceed those of conservation and re-use on a total system basis. Disincentives could include federal grant participation denial, denial of site application requests, etc.

3. Establish guidelines for levels of performance of water quality management programs which incorporate concepts of equity. Options for accomplishing this are: ⑤

a. Establishing a minimum stream standard which must be met statewide wherever attainable. (Attainability established as a concept where technical considerations and not economic ones preclude attaining the goals). ②

b. Establishing stream standards which vary throughout the state because of economic constraints but allowing for costs to areas with more stringent standards to be re-distributed. ②

c. Establishing procedures which will insure that the same degree of non-point source controls will be required by EPA and the State where circumstances are similar. ⑤

Thank you for the opportunity to present our perspective on this matter.

Sincerely,

Phil Overeynder
208 Coordinator

Lee R. Woolsey
Executive Director

cc: Gary Broetzman
208 Policy Advisory Group
Colorado 208 Directors
Colorado Dept. Natural Resources

RESPONSES TO COMMENTS RECEIVED BY THE NORTHWEST COLORADO COUNCIL OF GOVERNMENTS,
3 AUGUST 1977

1. Please see discussions in Volume 1, subsections III-7 and IV-7.
2. Please see discussions in Volume 1, subsections III-2 and IV-2.
3. Please see discussions in Volume 1, subsections III-3 and IV-3.
4. Please see discussions in Volume 1, subsections III-9 and IV-9.
5. Please see discussions in Volume 1, subsections III-4 and IV-4.
6. No response required.
7. Please see discussions in Volume 1, subsections III-8 and IV-8.
8. Please see discussions in Volume 1, subsections III-2 and IV-2 and III-5 and IV-5.

Regional Transportation District

RTD

1325 South Colorado Boulevard
Denver, Colorado 80222
303/759 1000

July 21, 1977

Mr. John A. Green
Regional Administrator, Region VIII
United States Environmental
  Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Dear Mr. Green:

The Draft Environmental Impact Statement for the Denver Regional Wastewater Facilities and Clean Water Program has been reviewed by the RTD staff with the following comments.

The statement addresses many relevant regional issues which generally have not been identified in other statements on subregional projects for discussion of the impacts of regional growth, regional development patterns and the conversion of agricultural lands, and the possible mitigation measures for these impacts is an important facet of the draft statement. The document serves to bring the growth and development issues into focus and at least begins to identify some potential methods for dealing with it.

On the negative side, the section on mitigation of air quality impacts mentions public transportation only indirectly in reference to bus and carpool lanes. The potential of an effective regional public transit system to assist in the reduction of VMT is totally ignored. Even under the most conservative estimates of future ridership on a region-wide transit system a general but not large improvement in air quality has been projected. Given the current energy situation and its implications with regard to limiting automobile use, a more significant impact on air quality (VMT) might reasonably be expected. A more complete discussion of these public transportation related issues should be included in your draft statement. ①

RTD will be happy to provide any necessary documentation to support this type of discussion. We will be glad to meet with you or your staff to discuss the issues identified.

Sincerely,

Ralph E. Jackson

Ralph E. Jackson
Director of Planning

REJ/hj

cc: Kenneth Slyziuk
    Sibyl Guereca

An Equal Opportunity/Affirmative Action Employer

RESPONSE TO COMMENTS BY
THE REGIONAL TRANSPORTATION DISTRICT
21 JULY 1977

1. Please see discussions in Volume 1, subsections III-1 and IV-1.

cc Murray

COSC
COLORADO OPEN SPACE COUNCIL 1325 DELAWARE ST. DENVER, COLO. 80204 303/573-92

August 8, 1977

Mr. John A. Green
Environmental Protection Agency
1860 Lincoln St.
Denver, Colorado 80295

Dear Mr. Green,

The Denver Regional Draft Environmental Impact Statement for Wastewater Facilities and the Clean Water Program has been reviewed by the Land Use Workshop of the Colorado Open Space Council. We find your effort to be one of the more comprehensive and thorough analysis' of growth impacts for the area we have read. We have always believed that an informed citizenry is essential for maintaining our environment. This statement clearly illustrates how educational and beneficial the EIS process can be when it is properly addressed and researched. We sincerely commend you and your staff.

The statement reiterates and confirms many of the concerns our group has voiced over the years; mainly that growth carries with its economic benefits a large package of negative, cumulative results upon the quality of our regional life. That our choices in the future are never going to be simple or inexpensive is made quite clear.

① We find two areas in the document we would like to comment on. Throughout the statement, the loss of agricultural land is sited as one of the large impacts within the region of projected growth. You quote a policy statement of DRCOG to the effect that prime farmland should not be converted to urban uses and urge that those areas to the north and northeast discourage urban growth. The question of how this can be achieved i not addressed as throughly as we would like. Land transfer taxes may be helpful, but it is our belief that such an action does not get to the heart of the matter which must consider the economic status of the farmer. We don't have a magic answer but certainly many more mechanisms exist than the land transfer tax for slowing down this trend. Purchasing development rights such as was done on Long Island, New York; creating agricultural districts as has been tried in Mesa County, Colorado or instituting a land gains tax similar to that in Vermont are all part of the attempt to handle this problem.

Secondly, we would urge that when and if funding is granted by the EPA for the proposed projects that such grants be contingent upon the resolution of some of the issues raised in the course of this statement. Certainly the size of the wastewater treatment plants should be an area of considerable discussion. It also seems appropriate to suggest that as part of the funding process some committment be extracted by EPA from the grant recipients to, at the very least, encourage individuals to lessen their dependence upon the automobile and to support the RTD. This could be achieved through funding some media progrmas, advertising, etc. As the automobile plays a major role in non-point pollution as well as air pollution, it should be targeted for some continuous, selective educational campaigns about the cause and effect relationships you have described. ②

COLORADO OPEN SPACE COUNCIL 1325 DELAWARE ST. DENVER, COLO. 80204 303/573-924

Again we commend the EPA for their diligent and detailed statement. It was well worth the hours spent reading. We look forward to perusing the final draft and offer any assistance we can give.

Sincerely,
Purnee McCourt
Purnee McCourt, Chrm.
Land Use Workshop

RESPONSES TO COMMENTS BY
THE COLORADO OPEN SPACE COUNCIL
8 AUGUST 1977

1. Please see discussions in Volume 1, subsections III-9 and IV-9.

2. A number of policies and conditions proposed by EPA are discussed in Volume 1 of this final EIS. For discussions pertinent to air quality, please see discussions in Volume 1, subsections III-1 and IV-1.

COMMENTS ON THE
DRAFT REGIONAL ENVIRONMENTAL IMPACT STATEMENT FOR WASTEWATER FACILITIES AND THE CLEAN WATER PROGRAM

BY THE DENVER CHAMBER OF COMMERCE TO THE
ENVIRONMENTAL PROTECTION AGENCY

AUGUST 15, 1977

COMMENTS ON THE
DRAFT REGIONAL ENVIRONMENTAL IMPACT STATEMENT FOR WASTEWATER FACILITIES AND THE CLEAN WATER PROGRAM BY THE DENVER CHAMBER OF COMMERCE TO THE ENVIRONMENTAL PROTECTION AGENCY

AUGUST 15, 1977

WE AT THE DENVER CHAMBER OF COMMERCE HAVE PARTICIPATED WITH INTEREST IN THE DEVELOPMENT OF THE CLEAN WATER PROGRAM OF THE DENVER REGIONAL COUNCIL OF GOVERNMENTS. WE HAVE REVIEWED THE E.P.A. DRAFT ENVIRONMENTAL IMPACT STATEMENT ON WASTEWATER FACILITIES AND THE CLEAN WATER PLAN, AND APPRECIATE THIS OPPORTUNITY TO OFFER OUR COMMENTS.

WE FIND IT ENTIRELY REASONABLE FOR THE E.P.A. TO DISCUSS THE BROADER SOCIO-ECONOMIC ISSUES THAT FACE THIS REGION, INCLUDING AIR POLLUTION, GOVERNMENTAL RELATIONSHIPS, LAND USE PATTERNS, AND TRANSPORTATION SYSTEMS. WE NOTE THE STATED PURPOSE OF THE DOCUMENT IS TO ELICIT A PUBLIC DIALOGUE ON THESE AND OTHER ISSUES, AND AS SUCH, THE E.I.S. IS AN EXCELLENT OVERVIEW. HOWEVER, WE ARE CONCERNED THAT SUCH A BROAD APPROACH MAY BE COUNTERPRODUCTIVE TO THE PURSUIT OF THE GOALS OF THE CLEAN WATER PROGRAM. ①

REGARDING THE SPECIFIC ELEMENTS OF THE ENVIRONMENTAL IMPACT STATEMENT, WE HAVE THE FOLLOWING CONCERNS:

WE CANNOT SUPPORT THE "NO-ACTION" ALTERNATIVE, WHICH AMOUNTS ② TO A NO-FUNDING POSTURE ON THE PART OF THE E.P.A. THE ADVERSE IMPACTS OF SUCH A POSTURE ARE NOT EXAMINED IN THE E.I.S., BUT MIGHT INCLUDE THE FOLLOWING:

1. IT IS UNLIKELY THAT NON-FUNDING OF WASTEWATER TREATMENT FACILITIES AND POLLUTION ABATEMENT PROGRAMS WOULD SIGNIFICANTLY

CONSTRAIN POPULATION GROWTH, ALTHOUGH IT WOULD CONTRIBUTE TO INFLATED HOUSING COSTS.

2. IT IS PROBABLE THAT LOCAL GOVERNMENTS WOULD BE UNABLE TO AFFORD THE ADDITIONAL ELEMENTS OF MORE ADVANCED WASTE TREATMENT NEEDED TO IMPROVE WATER QUALITY.

3. DEGRADATION OF WATER QUALITY AND STREAMSIDE ENVIRONMENTS WOULD CONTINUE AT AN ACCELERATED RATE; RECREATIONAL OPPORTUNITIES ALONG WATERWAYS WOULD BE LOST OR SEVERELY RESTRICTED.

4. THE EFFORT TO MAKE A SIGNIFICANT IMPACT ON THE IMPROVEMENT OF WATER QUALITY, WITHIN THE FRAMEWORK OF THE CLEAN WATER PLAN, WOULD BE VIRTUALLY CANCELLED.

THE ENVIRONMENTAL IMPACT STATEMENT APPEARS TO JUSTIFY THE OPTION OF NON-FUNDING OF WASTEWATER FACILITIES BY MAKING THE STATEMENT THAT THE ALTERNATIVES PROPOSED BY THE D.R.C.O.G. CLEAN WATER PLAN WILL NOT MEET THE 1983 GOALS. THE FEDERAL MANDATE OF FISHABLE AND SWIMMABLE WATERS IS, HOWEVER, QUALIFIED BY THE TERM "WHERE ATTAINABLE," AND THE INTERPRETATION OF SUCH A GOAL MUST REFLECT, INTER ALIA, A STRONG SENSE OF FISCAL RESPONSIBILITY. THE CLEAN WATER PLAN ALTERNATIVES ARE BASED UPON FUNDING PROJECTIONS SUPPLIED BY THE E.P.A., UTILIZE REASONABLE PRIORITY CRITERIA (BENEFICIAL USES), AND ATTEMPT TO DEVELOP A COST-EFFECTIVE PROGRAM ENTIRELY CONSISTENT WITH THE SPIRIT OF THE FEDERAL WATER POLLUTION CONTROL ACT. ②

WE SUPPORT THE FUNDING OF PROGRAMS TO DEVELOP CRITERIA FOR THE CONTROL OF NON-POINT SOURCES OF WATER POLLUTION (URBAN ③

RUNOFF) AS DESCRIBED IN THE E.I.S., INCLUDING A CONTINUAL STREAM-QUALITY MONITORING SYSTEM.

④ WE FEEL STRONGLY THAT THE REVIEW AND DISCUSSION OF THE CLEAN WATER PLAN GENERATED BY THIS ENVIRONMENTAL IMPACT STATEMENT SHOULD NOT DELAY THE APPROVAL OF 201 FACILITIES PLANS NOW BEFORE THE E.P.A. THE CLEAN WATER PLAN IS A DYNAMIC DOCUMENT LENDING ITSELF TO CONTINUED SCRUTINY AND REVISION IN THE COMING YEARS. DELAYS IN APPROVING FACILITIES PLAN, HOWEVER, RESULT IN UNJUSTIFIABLE COST OVERRUNS AND ADDITIONAL TAX BURDENS TO OUR CITIZENS.

⑤ THE DENVER CHAMBER OF COMMERCE HAS LONG SUPPORTED PROGRAMS TO DEVELOP REALISTIC AIR POLLUTION CONTROLS, INCLUDING AUTO EMISSION CONTROLS, AND TO BRING ABOUT REASONABLE LAND USE PLANS AND REGULATIONS. WE HAVE STRONGLY SUPPORTED EFFORTS TOWARD A MORE EFFICIENT AND BALANCED TRANSPORTATION SYSTEM FOR THIS REGION, AND WORKED FOR THE PASSAGE OF MEASURES AIMING AT THE CONSOLIDATION OF REGIONAL SERVICES, SUCH AS THE URBAN SERVICE AUTHORITY. WE ARE SENSITIVE TO THESE BROADER ISSUES AND APPRECIATE THEIR INCLUSION IN THE E.I.S. ④ WE MUST INDICATE, HOWEVER, THAT SUCH PROPOSALS AS THE ALTERATION OF OUR FORMS OF LOCAL GOVERNMENT, OR THE CENTRALIZATION OF LAND USE AUTHORITY, AS MAY SEEM APPROPRIATE TO THE E.P.A., CANNOT BE MADE PREREQUISITE TO THE GRANTING OF FUNDS FOR WASTEWATER TREATMENT FACILITIES. WE BELIEVE SUCH TACTICS STEP OUTSIDE THE BOUNDARIES OF E.P.A.'S PEROGATIVE AND AUTHORITY.

RESPECTFULLY SUBMITTED

Howard D. Hicks

HOWARD D. HICKS
STAFF PROJECT MANAGER
DENVER CHAMBER OF COMMERCE

RESPONSES TO COMMENTS BY
THE DENVER CHAMBER OF COMMERCE
15 AUGUST 1977

1. Please see the Introduction to Section V, Volume 2.
2. Please see Section III, Volume 2.
3. Please see discussions in Volume 1, subsections III-5 and IV-5.
4. Please see discussions in Volume 1, subsections III-4 and IV-4.
5. Please see discussions in Volume 1, subsections III-1 and IV-1.

ENVIRONMENTAL PROTECTION AGENCY PUBLIC TESTIMONY

Marriot Hotel

July 18, 1977

Re: Environmental Impact Study/Clear Water Plan

This testimony is very much in support of parts of PL 92-500. The Denver County Republican Party water task force encourages the cleaning up of our water ways, streams, air polution and in general our environment as a major city continues to grow. The West and Southwest are presently absorbing the major population shifts from the East as forecasted long ago by United States Census and private research teams. In addition to this natural phenomena is the recent focus of the world to the many energy resources in Colorado and the West. President Carter has emphasized many times our future dependances on the West for her coal, uranium, natural gas, shale oil. The President of Richfield Oil recently announced that if the price of world oil continues to rise at the present rate, by the year 2000, coal will be the Nations number one source of energy. Also announced last week was the expected move of United California Bank and many other major financial institutions to move into the Denver Metropolitan area as the financial arm to the energy industries.

This concentration of industry with its army of employed is certainly going to have a major effect on Metro Denver in providing shelter, food, water and municipal services and also places a tremendous need for masterful, long range planning.

PL 92-500 gives the Environmental Protection Agency the power to administer and enforce the various sections of that law, specifically sections 201 and 208. This is the planning and development of systems to clean polutants of air and water and the environment.

Environmental Protection Agencies Environmental Impact Statement to Denver Regional ① Council of Governments Clean Water Plan explains in detail the various problems the Denver Metro area faces, but sheds little light on progressive measures to put our various waste water treatment facilities in compliance with PL 92-500. Instead, it seems to me, that the Environmental Protection Agency is saying "Stop Federal funding to Denver for waste treatment which will effectively stop the population growth and therefore the need for improved waste treatment facilities will no longer be needed." Now gentlemen, that is a direct contradiction to the governments decision to develop the West! Where then do we put the people? Ship them in from Alaska?

Section 208 also requires that air standard qualities and non-point water polution sources be contained to its minimum. To stop the non-point source of polution, says Environmental Protection Agency, we must stop urban sprawl. To clean the air qualities of the cities we must stop driving our cars. Here, it seems to me, is a glarring example of the divergence of planning by at least three government bodies. The Secretary of Transportation, two years ago, refused RTD funding for a mono-rail system which if in use would greatly reduce the amount of air polutants in the city. Reason given for the decision was that the population in Denver would not support this form of mass transportation. In other words, come back when you have a larger population. What do we do with the air in the meantime?

HUD also is spending millions of dollars to attract people back into the city. But the Environmental Protection Agency says in its Environmental Impact Statement, stop growth in the Denver Metropolitan area to reduce the amount of air and water polutants.

Finally, President Carter, before his election promised to work closely with local ② municipal governments to work out the nations cities problems. Now we see in PL 92-500 that Section 208, regional planning on a Federal basis with the blessing of the Govenor, is encouraded over Section 201, planning on a local project-by-project basis, which is encouraged by the Environmental Protection Agency. I ask, does the Carter administration really want to work with local government, regarding local problems or would it prefer to turn the entire local water and water treatment problems to another Federal Bureaucracy?

The Republican Party Denver Water Task Force strongly urges the Environmental Protection Agency to work closely with Denver Regional Council of Governments and the local municipalities in solving the waste water and air polution problems and encourages Federal funding to local municipalities for needed treatment facilities to meet the ever increasing population and industrial growth in the Denver Metropolitian area. Today is the time to stop the decision process of whether Denver needs Federal funding and start immediately to implement the projects which are now so badly needed.

Rik Toren
GOP DENVER WATER TASK FORCE, CHRMN.

RESPONSES TO COMMENTS BY
THE DENVER COUNTY REPUBLICAN PARTY WATER TASK FORCE
18 JULY 1977

1. Please see discussions in Volume 1, subsections III-1 and IV-1.
2. Please see discussions in Volume 1, subsections III-4 and IV-4.

Statement Concerning the Regional Draft EIS For Wastewater Facilities and The Clean Water Program

The Denver Sierra Club commends the Environmental Protection Agency for taking a long necessary approach in the study of the effects of a plan of action-in this case concerning wastewater facilities. The EPA has done a fine job of trying to stimulate thought concerning all aspects of the area that will be effected by continued population growth.

The Denver Sierra Club would like to see the growth rate of the area cut back to a minimal amount before 1980 otherwise we fear that water, air, land and other tangible qualities will be irreparably damaged. The suggested growth control recommendations in the DEIS are wholeheartedly endorsed.

"1. Prohibit floodplain development and/or require a 200 foot stream setback. ①
2. Minimize impervious areas and vehicle areas and vehicle use.
3. Provide for the collection and temporary storage of initital or low volume runoff from commercial and industrial sites for evential discharge and treatment by wastewater treatment plants during off peak hours.
4. Ban the use of septic tank leach fields."

To the goal of growth control a land use program that protects agricultural land against "irreversible" conversion to other uses and legislation to enact a Family Farm and Antitust Act in Colorado and Region VIII would be most useful. Funding for water and waste water treatment should not be provided where loss of prime agricultural land is involved. Additionally EPA should use its EIS powers to minimize development of prime agricultural land. ②

The Denver Sierra Club feels that the agricultural segment should have preference where water consumption is concerned, and also feels that there could be more sharing of water rights between municipal and agricultural users, i.e. where the urban area first uses the water and forwards it on to the farmers somewhat enriched in nitrogen and phosphorus content. A change in water laws as outlined in the DEIS to include an Agricultural Land Transfer Tax or outright buying and releasing to family farmers in the form of a Land Trust should be investigated. ③

Certainly conservation of water measures are necessary, especially though the means suggested in the DEIS, they are.... ④

"1. Continuing education programs on the need and ways of conserving water.
2. Metering of all water users so that excessive use can be determined and water conservation measures enforced.
3. Establish water use goals with a" progressive "rate structure for excessive use.
4. Ban the sale and installation of water using appliances that use excessive amounts of water."

Please note that point #3 has been altered to require progressive rather than the presently stated "regressive"water rate charges. If the rates are higher per unit as the rate of useage increases then there is less likely to be excess waste.

The Denver Sierra Club would like to see the recent EPA education ⑤ campaign expanded to include composting toilets and municipal code changes to allow their installation and use in Metropolitan areas as well as discouragement of garbage grinders in kitchen sinks,and a stablizing in the number of water tap connections.

EPA, Congress, Legislatures and City Administrators, including Sanitary Engineers must be reoriented to change over from the traditional municipal ⑥ wastewater treatment plant improvements to a dedication to a program based on land application of sewage and effluent until such a time as the composting toilet is made available to all. We would hope that the increased soil value of land application would be taken into account when considering the cost effectiveness of land application in the Clean Water Plan.

The Denver Sierra Club would like to see a change from the present ⑦ contests for lawns with imported grasses, to contests concerning those grasses which are indiginous to our arid land.

A Denver Regional Council of Governments monitoring system is imperative and point source control must be enforced for water quality, especially ⑤ where industry is concerned; potentially toxic industrial wastes must be controlled at the source as is presently being attempted.

Non-point source pollutants can be minimized by introducing a weekly street cleaning program by the municipalities and/or home owners and with enforcement of local municipal codes concerning the "depositing or littering in ① streets, alley ways, or any public place, ashes, bottles, cans, garbage, glass, nails, tacks, rubbish, trash, wastepaper, wire, or other waste materials or any snow, or ice removed from private property" (Denver Municipal Code 135.12).

A weekly street cleaning program would also reduce particulates in ⑧ the air. Demonstration studies must be instituted regarding volume of traffic, sanding and salting programs, especially in high volume areas, in conjunction with regional transportation systems as substitution for the automobile. More bicycle paths should be built and downtown roads should be made safe for such vehicles. There are also needs for parking for bicycles which are not now met.

Natural gas shortfalls and secondary impacts on electrical power ⑦ generators and distribution must be allocated on the basis of SOCIAL needs - not on industry production demands and not on products using the most energy and least basic to the full vital needs of the people. We need to have a full intensive continually expanding PR program concerning both energy and water usage in the region, especially. Consolidation of responsibility while making it easier for the for the EPA to effctively carry out the mandates of Congress by no means insures that the reorientation necessary will automatically occur. This will only happen when EPA enormously increases its grass roots education of the U. S. population.

Respectfully Submitted,

of the Denver Sierra Club
1935 Delaware Street
Denver, Colorado 80204

RESPONSES TO COMMENTS BY THE DENVER SIERRA CLUB

1. Please see discussions in Volume 1, subsections III-5 and IV-5.
2. Please see discussions in Volume 1, subsections III-9 and IV-9.
3. Please see discussions in Volume 1, subsections III-6 and IV-6.
4. Please see discussions in Volume 1, subsections III-7 and IV-7.
5. Please see discussions in Volume 1, subsections III-4 and IV-4.
6. Please see discussions in Volume 1, subsections III-3 and IV-3.
7. This comment is acknowledged.
8. Please see discussions in Volume 1, subsections III-1 and IV-1.

Historic Denver, Inc.

June 23, 1977

TO: United States Environmental Protection Agency

FROM: Historic Denver, Inc.

RE: Denver Regional Environmental Impact Statement for Wastewater Facilities and the Clean Water Program

Historic Denver's major concern is with the aspects of the EIS which deal with historic sites and buildings. The list of major historic sites, given on page A 59 in the Appendices, does not adequately cover the major cultural resources ① found in Denver and surrounding areas. The list should include all the buildings, sites, and districts that have been designated as landmarks by city or county ordinances and those listed on the National Register of Historic Places. These are available at the Denver Planning Office and the State Historical Society of Colorado.

Historic Denver recommends that local and state inventories and surveys be consulted during the planning process. The Revised Denver Inventory, available through the Denver Planning Office, gives listings by neighborhoods of buildings and districts designated as Denver Landmarks and listed on the National Register. It also lists those qualified for landmark designation. Attention should be given to those buildings, sites, and districts that are in the process of landmark designation, either local or national.

It should be noted that the surveys and inventories are not definitive on what is significant. They are a record or listing of information known at a particular point in time and are subject to additions or deletions at a later date.

Every effort should be made to determine what cultural resources are in the project areas through the use of all available information.

Barbara Norgren

Barbara Norgren
Preservation Consultant

770 Pennsylvania Street • Denver, Colorado 80203 • 303/837-1858

RESPONSES TO COMMENTS BY
HISTORIC DENVER, INC.
23 JUNE 1977

1. Information is acknowledged and appreciated. Volume 1, subsections III-9 and IV-9 address this issue and present EPA's proposed policies.

July 25, 1977

Mr. John A. Green
Regional Director
Environmental Protection Agency
1860 Lincoln Street
Denver, CO 80295

Dear Mr. Green:

On behalf of the Jefferson County Board of REALTORS, I am responding to your request concerning citizens input on the Environmental Impact Statement prepared on waste water facilities for the Denver Metropolitan area.

It appears that the EID takes the strategy of holding out to the general public ①
that the lack of construction of sewer facilities will control growth in the Denver
Metropolitan area. I would suggest to you and the EPA that the control of growth
is a concern of the Jefferson County Board of REALTORS and the public. For
the EPA to choose waste water treatment facilities as the mechanism to control
growth in the metropolitan area is ridiculous. I do not believe it is the intent of
Congress to control growth in the Denver metropolitan area through Public Law
92-500. It appears to me that the goals of Public Law 92-500 are not possible ②
without the complete ruination of the current economic and social structure of
the metropolitan area. I would suggest that the Environmental Impact Statement
speak to the issue of the difficulty in reaching the goals as presently set, and
should offer some solutions as to how these goals should be amended in order to
be reached within a reasonable time and economic framework.

③ I also believe that the Environmental Impact Statement summarily dismisses Land Application Sewage Treatment without any analysis of the advantage of this system. Although your report does make references to the health dangers of land application, I would draw your attention to the use of land application since 1898 in Sidney, Australia. Government research indicates no deaths or adverse health effects attributable to this Land Application Method. It would appear that the Environmental Protection Agency, in the semiarid Denver Metropolitan region should concern itself with this viable method of sewage treatment. Just to continue to build concrete treatment plants is not a good use of our money, nor is it a good use of the energy available to this country. The Jefferson County Board of REALTORS would prefer to see your agency concentrate its efforts on establishing economically efficient sewage disposal systems, such as land application, instead of your agency attempting to establish growth control policy for the Denver Metropolitan region.

Your consideration of these ideas will be appreciated by the Jefferson County Board of REALTORS. I hope that you will further analyze the Environmental Impact Statement as prepared and change it to reflect the reality in which we live and our ability to solve our problem within the money available to us.

In addition, I must tell you of my displeasure with the slide presentation at the public hearing on July 19, 1977. This presentation was not anly ill conceived, but not informative. I expect more sophisticated treatment of the environmental problems facing the Denver Metropolitan area than was expressed by that presentation. ④

I appreciate the opportunity to respond to your Environmental Impact Statement and hope that my input will be helpful.

Sincerely,

C F Shanks, Jr.

Capp F. Shanks, Jr.
Governmental Liaison
Jefferson County Board of REALTORS

RESPONSES TO COMMENTS BY THE JEFFERSON COUNTY BOARD OF REALTORS

25 JULY 1977

1. Agreed. Environmental Protection is EPA's primary concern. Please see Discussions in Volume 1, subsections III-4 and IV-4.

2. Please see discussions in Volume 1, subsections III-2 and IV-2.

3. Please see discussions in Volume 1, subsections III-3 and IV-3. See also EPA's responses to comments from the City of Northglenn, pages 290 and 295.

4. Please see the Introduction to Section V, Volume 2.

Gambles
9456 West 58th Avenue
Arvada, Colorado 80002
July 22, 1977

Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80295

Attention: John Green

Dear Mr. Green:

As chairman of the Legislative Forum of the Arvada Chamber of Commerce, it has been brought to my attention that the "No Federal Funding" alternative for waste water treatment facilities is really not an alternative. This approach would cast an unbearable burden upon municipalities and would therefore be passed along to the home owner and rentor and businessman. ①

While I do not presume to speak for the group, it is my opinion and the concensus of the group, that a protest to the "alternative" be registered.

Respectfully,

Robert A. Close

RESPONSES TO COMMENTS BY
THE LEGISLATIVE FORUM OF THE ARVADA CHAMBER OF COMMERCE
22 JULY 1977

1. EPA agrees. See Volume 1 for a description and discussion of EPA's planned actions and policies.

metro* denver
league of women voters

1600 Race Street
Denver, Colorado 80206

July 27, 1977

Mr. John Green
Regional Administrator
USEPA
1860 Lincoln
Denver, CO 80203

Dear Mr. Green:

The League of Women Voters of Metro Denver has been concerned for sometime about the lack of coordinated and comprehensive planning in the Metropolitan area. The Draft Environmental Impact Statement for Wastewater Facilities and the Clean Water Program goes a long way in addressing this need. We are very supportive of the evaluation done by the Environmental Protection Agency of the environmental impacts of attaining cleaner water and air in the Denver Metropolitan Region. The EPA has done an excellent job in setting forth issues that need to be resolved. We also wish to commend the Agency on its attempt to involve the public through slide presentations, a newspaper supplement and public hearings.

The League supports the local alternative with a plant on Clear Creek as presented in the EIS. The construction or expansion of local facilities would allow for more innovative approaches in the utilization of water, an obviously scarce resource in this region. ①

The consolidation of wastewater treatment facilities at only a few sites as presented in the regional alternative is unacceptable. This approach would, we believe, foreclose the development of efficient reuse, exchange, and land application schemes. We should have learned by now, from experience in other Metropolitan areas, that large regional plants are not the answer. ①

We do not support the no action alternative. Efforts to reduce the amount of pollutant loadings from point sources is essential even though pollutants from non-point sources will continue to increase. The control of non-point sources is a relatively new issue being addressed by the nation. We should proceed to address this difficult problem through all means available taking into consideration the attendant social, economic and environmental factors. Adopting the no-action alternative would be costly to the region and would allow for a further delay in the reduction of non-point sources of pollution. ①

The problems surrounding control of non-point sources have been adequately addressed in the Draft EIS prepared by EPA. However, the Denver Regional Council of Government's 208 plan is lacking in this area. A more aggressive stance should be taken and an institutional arrangement must be established which will allow for the control of non-point sources of pollution. ②

The LWV of Metro Denver believes that the 208 plan as presented in the Draft Clean Water Plan should be adopted. While we agree that there are some serious ③ weaknesses in the plan, they can probably be better dealt with if a compliance schedule for upgrading the plan is adopted. Funding for upgrading and implementation must be considered. There is real concern that without further funding plans developed under Section 208 will not be implemented.

The DRCOG 208 plan has devised an institutional arrangement which we believe should be consolidated further. Funding decisions by EPA should be easier to make based on a more coordinated approach. ③

There are a few specific points which we think should be more fully addressed in the EIS.

It would appear that the EPA is over emphasizing the construction of treatment plants to improve water quality. More consideration should be given to land application methods. Colorado requires secondary treatment for land application and where indicated a system should be devised so that the beneficial properties of effluent can be utilized. It seems somewhat incongruous, considering the energy problems facing the nation, to remove at a high energy cost, nutrients which then will be replaced by fertilizer which also saps our energy supply. ④

Utilization of secondary effluent may go a long way to retain agricultural land and open space. Informal systems of land treatment (including sludge) have been used all over the United States. In addition, there have been more formal systems such as application to golf courses and parks. Continuation of these practices should be considered. ④

We disagree with your proposal to ban septic systems. The construction of interceptors to collect waste from remote areas may be very disruptive to the environment and may open up additional areas for development. We would suggest that septic systems if constructed properly and cleaned and inspected regularly may be more appropriate in some areas. Also, installation of septic systems for small rural communities should be investigated. These systems could be required to be monitored and maintained. ③

We appreciate the innovative approach taken by the Environmental Protection Agency in addressing the air and water problems of the region as a whole and not on a project by project basis. We would hope that the document would be a basis for much decision making, and that it will be further refined. Much of the refinement must come from decision makers and citizens in the area. We, as one organization, will attempt to work on this aspect in the future.

Sincerely yours,

Toni E Worcester
Toni E. Worcester
President

cc - Douglas Costle
Gary Broetzman
Bob Doyle
Bill Geise
David Pampu
Jack Hibert

RESPONSES TO COMMENTS BY
THE METRO DENVER LEAGUE OF WOMEN VOTERS
27 JULY 1977

1. EPA essentially agrees.

2. Please see discussions in Volume 1, subsections III-5 and IV-5.

3. Please see discussions in Volume 1, subsections III-4 and IV-4.

4. Please see discussions in Volume 1, subsections III-3 and IV-3, and responses to City of Northglenn's comments pages 290 and 295.

7626 Oak Street
Arvada, Colorado 80005
July 17, 1977

Environmental Protection Agency
1860 Lincoln
Denver, Colorado 80295

Attention: John Green

Dear Sir:

I intend to obtain a copy of the draft Denver Regional Environmental Impact Statement for Wastewater Facilities and the Clean Water Program.

In addition, I wonder if there is any regularly published literature that will help me keep up to date on the issues you have covered and current activities related to them.

I am gravely concerned about the projected growth in the metropolitan area and its consequences. ①

Thank you.

Mrs. N. J. Besch (Patricia)
422-5852

RESPONSE TO COMMENTS BY
MRS. N. J. BESCH
17 JULY 1977

1. EPA Region VIII has joined with the Energy Research and Development Administration and other federal agencies to establish and fund an energy/environment information center at the Denver Public Library. The center's staff provides information search and retrieval services, referral services and acts as a depository for important regional information.

9905 W. 21st Ave., #4
Lakewood, Co 80215
July 13, 1977

Bob Doyle
Environmental Protection Agency
1860 Lincoln
Denver, Co 80295

Dear Mr. Doyle:

My congratulations on EPA's "It's Your Future...". I can't tell you how happy I feel when I see someone looking at Denver's growth from a view point other than monetary! ①

Please send me: "The Denver Regional EIS for Wastewater Facilities and the Clean Water Program." and any additional information.

I would also appreciate receiving EISs on the Foothills and Two Forks Projects.

Thanks,

Dan Chiras
232-6868

RESPONSES TO COMMENTS BY
MR. DAN CHIRAS,
13 JULY, 1977

1. No response required.

Walden

7 July 1977

Mr. Robert Doyle
U.S. Environmental Protection Agency
Region VIII
1860 Lincoln Street
Denver, Colorado

Subject: Draft EIS for Denver Regional Wastewater Facilities
and Clean Water Program

Dear Mr. Doyle:

I wish to comment briefly on the draft EIS. During the past two years I have had an opportunity to study some of the environmental issues concerning Rocky Mountain Arsenal near Denver, Colorado. Through site visits, discussions with Denver USGS personnel, visits to Boulder, Colorado institutions, and a review of U.S. Army documents, I have become acquainted with studies of groundwater aquifers, waste disposal, and wildlife in the Denver area.

The subject EIS is a concise and generally clear discussion of the principle
impacts involved in the proposed actions. However, a close reading of ①
Section II revealed that, in keeping with the overall program priorities,
the biology portion has received only a superficial treatment. You may
wish to reexamine this section.

The "Biology" section (page II-43) is of uneven quality. For example, in the first paragraph we are told in very general terms that human settlement has brought great ecological changes, obliterated many wildlife habitat areas, caused almost no effects on several steppe community areas, and even replaced lost habitat and increased ecological diversity in other areas. In the final sentence one learns of only potential danger to several animal species and to no plant species. This introductory paragraph gives the impression of some bad and some good ecological effects, but does not come to a definite conclusion. It is imperative that this informational document reach a conclusion based on scientific data.

The second paragraph describes Denver in very general terms, but is unduly qualitative. With the exception of the words heron, cottonwood, and willow, there is no mention of genera or species. Likewise, there is no mention of the size of the wildlife areas in either miles of shoreline or acres of water bodies, gallery forests, or grasslands. We are given no idea of the extent of cold or warm water fisheries within the city.

WALDEN DIVISION OF Abcor INC.
850 Main Street □ Wilmington □ MA □ 01887 □ 617/657/4250 Telex 710 3476537

The introductory sentence to paragraph three - "In the outlying areas, human activity is less intense and many areas still retain much of their natural condition." - is misleading. For instance, prairie dogs are numerous, not in the (farm) areas surrounding Denver, but in areas south of Denver and in areas, such as Rocky Mountain Arsenal, which are strictly controlled. The two sentences on the black-footed ferret are misleading. Are there any black-footed ferrets in Colorado?

The biology section, as written, consists of four paragraphs:

1. Introductory nonsense;
2. Nature travelogues of Denver;
3. Inaccurate, incomplete descriptions of unusual or rare mammals and birds in outlying areas; and
4. Fire hazards.

To more properly satisfy NEPA intent, you should provide meaningful baseline documentation against which to judge the impact of the proposed actions. It is urged that you alter your format to include:

1. Areas (acres) of each major type of habitat (including human dominated uses, such as farming and residential) for outlying areas and for Denver;
2. Principal vegetation types -

   Native vegetation
   Introduced vegetation
   Farm crops

3. Principal species and habitat requirements -

   Mammals
   Birds
   Fish
   Amphibians

4. Factors which have altered the range and abundance of principal plant and animal species -

   Direct loss of habitat due to construction
   Loss of habitat due to farming
   Fire
   Changes to water courses
   Loss of prey species

In summary, the vague statement you offer should be replaced by more quantitative statements available from the scientific community.

Sincerely,

David R. Cogley

David R. Cogley
Manager
Environmental Studies
Technology Development Department

DRC:ccr

Enclosure

ATTACHMENT A: ADDITIONAL COMMENTS

Page	Comments	
II-5	Table II-A. The primary standard for particulate matter reads "75 μm^3", but should read "75 $\mu g/m^3$".	②
II-21	Paragraph two, second line. "Bartonitic" should read "bentonitic".	③
II-34	Table II-H. Under "dissolved oxygen" average and peak values are listed. Minimum values should also be listed. The reason being that ecological stress occurs at low oxygen levels. Low dissolved oxygen levels limit stream productivity.	①
IV-63	Table IV-Q. The "Alternative Classification Levels" specified in this table are of limited value as they stand. Table IV-Q should be improved by combining salient aspects of Table II-D (II-29) so as to be of maximum utility to the reader.	④
Map E	The most north-westerly "perennial lake" on Rocky Mountain Arsenal is not a lake, but rather an asphalt lined waste basin (Basin F) devoid of wildlife.	⑤

RESPONSES TO COMMENTS BY
MR. DAVID R. COGLEY,
7 JULY, 1977

1. Please see the introduction to this section.
2. This error has been corrected in Section II of Volume 2 (p. 19).
3. This error has been corrected in Section II of Volume 2 (p. 32).
4. Table IV-Q in Volume 2 has been amended as recommended (p. 175).
5. This comment is acknowledged.

John Green
Environmental Protection Agency
1860 Lincoln
Denver, Colo. 80295

Dear Mr. Green:

Just heard a discussion of the E.P.A. proposal on Wastewater Non Funding for the Denver Metro Area. ①

This seems to me to be an unrealistic approach to the problem. While water quality is important to all of us we must use a reasonable approach to solve the problem.

I would urge you to closely review the Denver Regional Council of Government recommendation - as well as correspondence from the "Elected" officials in the Metro area.

Jim Fisher
Arvada

P. S. The elected local officials - have a better sense of the pulse of the community than the "Sierra Club" - or a non elected Federal government employee. The elected officials on a local level represent the Silent majority. -- Please heed their advice.

RESPONSES TO COMMENTS BY
MR. JIM FISHER

1. As a result of EPA and public review of the Draft EIS, EPA has decided that the no-action (non-funding) alternative is not the appropriate course of action. Volume 1 of this EIS explains EPA's decisions.

500 EQUITABLE BUILDING
730 SEVENTEENTH STREET
DENVER, COLORADO 80202

July 14, 1977

Mr. John A. Green
Regional Administrator
U. S. Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Dear Mr. Green:

Thank you for your notice headed "We are Looking for your Ideas".

I was a member of the Water Quality Task Force ① which prepared the DRCOG report. I also received the four volume EIS from the EPA, which I have read. My chief interest is to hold down the overall growth, as well as the sprawled nature of metropolitan growth, in order to prevent worse air pollution. I have some knowledge in this matter as trustee of the Webb-Waring Lung Institute.

Keep up the good work.

Yours cordially,

John L J Hart

John L. J. Hart

JLJH:js

RECEIVED
JUL 15 1977
Planning Branch
[illegible] and Water Programs Division

RESPONSE TO COMMENTS BY
MR. JOHN L. J. HART,
14 JULY, 1977

1. No responses required.

14632 E. Carpian Pl.
Denver 80232
July 10, 1977

Environmental Protection Agency
1860 Lincoln Street
Denver, Co 80295

Bob Doyle

Dear Sir:

This is to say the American Public is anxious for our leaders to tell us the truth and to take action for a better future.

We need one unified government for the Metro area, in all matters. ①

We can treat and re-use waste water. We must do so for the growth that is inexorable.

We must maintain rigid standards for air quality control, if we all have to drive Hondas.

We must plan the use of our land, keep good agriculture land for that purpose, build on marginal land, maintain open space and generally plan ahead for growth rather than reacting after the fact.

There are so many matters of interest to me in your ad that I would appreciate receiving your synopsis mentioned in the body of ad.

I feel, after reading the supplement and responding to the questionnaire, that Mr. Green and staff are ready and able to give us some real facts and answers and leadership.

I would like to become involved in this effort.

Yours,

Cal Harvey
Res. 750-5608
Off. 837-8842

RESPONSE TO COMMENTS BY
MR. CAL HARVEY,
10 JULY, 1977

1. No response required.

Environmental Protection Agency
1860 Lincoln
Denver, Colorado 80295

Attention: John Green

Dear Sir:

I am here as a private citizen because I was incensed when I read proposal #2, the one with regard to superseding the local governmental authority & the surrendering of same to "Metro" professionals who will replace elected officials, thereby giving up our rights as private citizens to make our own land development decisions.

* The question is - would the formation of regional government mechanisms be acceptable? My answer is NO - and I urge each one here if, indeed, this comes to a vote, not to be hoodwinked by these Metro plotters who seek to destroy local self-government on the pretext of water treatment - air pollution or anything else. ①

Bonnie Irvine

RESPONSES TO COMMENTS BY
MS. BONNIE IRVINE

1. Please see discussions in Volume 1, subsections III-4 and IV-4.

THE REGENTS OF THE UNIVERSITY OF COLORADO

Byron L. Johnson
Chairman, Board of Regents
2451 S. DAHLIA LANE
DENVER, COLORADO 80222

July 18, 1977
To the EPA
Re: Regional Impact Statement for Wastewater Facilities--Denver region

When I represented all of Denver's suburbs in the 86th Congress, I found that we had 55 separate wastewater districts, no cooperation, and terribly inadequate facilities. There was no incentive to cooperate. ①

Working with John Blatnik, HEW, and others, we got the Clean Streams Bill written so as to encourage cooperation. We held a session in Denver with State and local officials, leading to the creation of the Metropolitan district. Our major mistake was in making it an option, rather than a necessity, to cooperate. Our second mistake was in making it a single purpose district, rather than a metropolitan services district, so that land use, transportation, water supply, and fire protection ~~were~~ would have been among the services related to wastewater questions.

Working with Floyd Haskell, William Armstrong, and others we subsequently drafted a constitutional amendment which began as a metropolitan services authority, but emerged as a regional services authority, so that any group of counties in the State could use the new tool. This was approved in the 1970 election. Working with DRCOG and the legislature, we also got the enabling statute approved. We now need to take the final step of using the regional tool as it was designed to be used.

Any help that EPA can provide, or encourage the Federal Government to provide, will be most welcome. My interest in these matters goes back 35 years, to my service in the US Bureau of the Budget during World War II when I was deputy to I. M. Labovitz on the desk for intergovernmental relations. I was drafted from there to the Social Security Administration to be a grant-in-aid expert, and became even more convineed that the Federal Government is, by neglect, encouraging proliferation of local governments, and by timidity, failing to encourage the kind of metropolitan cooperation that we have known we need for at least four decades.

But we need Uncle Sam to pull his act together, and lead us into patterns of cooperation on land use, transportation, water, wastewater, libraries, welfare housing, police and fire protection, and other matters that can only be reasonably efficient as they embrace the whole of a major metropolitan area.

If the Congress would agree to share with a regional or metropolitan agency having adequate power and authority a sum equal to 3% of all personal income tax collections from residents of the region, I daresay you could encourage such cooperation. This could be the carrot. ①

You may want to think about a stick--such as charging up-stream polluters for the costs of helping downstream users purify the sewage so they can drink it. This is easy to imagine against corporations--but can you figure out how to apply it to metropolitan cities and smaller towns? I cannot. ①

Reproduced from best available copy.

You raise questions also about air pollution, energy, and transportation. With better land use planning, we could use more high density clusters in planned unit developments and design away from the need for so much reliance upon personal automobiles. With automated guideway transit for goods as well as persons between such clusters and other activity centers, we could shift from polluting to non-polluting transportation. With electric cars and mopeds we could sharply reduce the remaining pollution from internal combustion engines, regardless of the success of emission controls at this altitude. ②

With more encouragement of energy conservation, as well as of the use of solar heating, we can cut fuel requirements further, and help clear up the air. ③

The Federal Government could do much to encourage introduction of total energy systems into major apartment complexes, with high temperature solar collectors being used first for power, then for space and hot water heating. Because EPA seems to expect more coal fired plants, it seems appropriate to suggest that these be built where new housing is going in, so that the waste heat can be converted into space and hot water heating, rather than thermal pollution of air and water. ③

If Colorado gains another 750,000 people by 1990, as it may, and if each family were to want a five acre tract, and they were to settle east of the Front Range, they would consume a strip of land equivalent to 1800 square miles, or a strip the full length of the state, south to north, six miles wide. If these 750,000 were to live in clusters averaging 15 family units to the acre, they would need no more than 24 square miles, for their housing. And service to them would require less utility lines, less water, less roads, etc. ③

We expect Uncle Sam to pick up more and more of the tab. Perhaps Uncle ought to set some standards of reasonableness before he pays the bill. ①

The EPA could help us all take better care of our rich patrimony by preaching a gospel of stewardship. We don't really own the land in fee simple, or any other way. We can't take it with us when we go. We are truly but trustees of the land for our children and their children's children. Only as we come to see the long run impact upon generations yet unborn of our reckless use of all land, air, and water do we begin to recognize the need for a sense of stewardship over these resources. It is a stewardship in which we all share: tenants, landlords, local governments, corporations, States, and the Federal government--alike. We have been a State for a century, and the frontier was really closed when we were admitted to statehood. We need a larger vision for the next century, and the centuries to come. The practices that could be tolerated in the first century, and in part of the second, can no longer be accepted for the third. We cannot move on any longer. The frontier is closed. Either we reduce the pollution, or it reduces us. ③

Byron L Johnson

Reproduced from best available copy.

RESPONSES TO COMMENTS BY
MR. BYRON L. JOHNSON
18 JULY 1977

1. Please see discussions in Volume 1, subsections III-4 and IV-4.
2. Please see discussions in Volume 1, subsections III-1 and IV-1.
3. Please see discussions in Volume 1, subsections III-8 and 9, and IV-8 and 9.

Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80295

Attention: Mr. John Green

Dear Sir:

① AIR CONTROL: I believe this is important but the government as usual follows the most complicated course in the effort to decrease air pollution. They are now on the right track by demanding higher milage per gallon of gas. This can be increased substantially by eliminating all the mechanism on the autos. We all should realize that by burning one gallon of gas in 35 miles without any pollution control we will pollute considerably less air since the engine will burn most of it using so little gas.

② WATER QUALITY: This is extremely important since it involves the health and welfare of the public. This is a must for government control and costs money. Recycling will cost more but we have a limited supply of water and it must be utilized to the maximum.

③ URBAN LAND USE PLANNING: Land use will take care of itself. Houston, Texas has no zoning or land use legislation and is a model city. The lenders, appraisers, and estute builders will better make the determination of land use through economics than any public body. Also, the availability and cost of utilities, marketability and location should determine land use. Land use is the most unfair and unconstitutional legislation to any land owner. Often land use is determined by voters pressure on the elected officials. The same is true of zoning, but is not always the best policy, since everyone is looking out for only themselves and their personal interest. The free market will best determine land use.

③ RECREATION AND OPEN SPACE: This is fairly important and Senate Bill 35 already requires a donation of 10% of the land to be donated by every developer for public use. In addition often the developer is required to supply funds to develop the open space and recreation area. Many of the developments have their private recreation areas controlled by the owners association. I believe that we have sufficient legislation at present.

AGRICULTURAL LAND USE: This also is mostly determined by the free market ④
enterprise; farmers cannot continue to grow crops at a loss. It is very
important that good farm land be conserved, especially in low lands and
flood plains which has the best production but this is very limited and
other land is needed. Recycled water should all be used for agriculture ⑤
where it is not used for domestic use. We need more dams and reservoirs ⑥
limiting to a minimum the flow of our fresh water into the sea.

⑦ ENERGY CONSERVATION: This is most necessary since there is only a limited amount of all resources in the earth and one day will be depleted, not during our lifetime but in some future generation. Every effort should be made to find new sources of energy, wind, solar, possibly some yet to be discovered.

⑦ ENVIRONMENTAL IMPACT STUDIES: This was not mentioned in your questionnaire but is one of the most ridiculous monsters ever conceived. Nowhere can anyone establish a definite criteria to evaluate the environmental impact of many things. I have found that environmental impact studies are evaluated mostly on the basis of how favorable any project appears to the judge of the impact study; it is like beauty to the beholder. The environmental impact studies could be made meaningful if they eliminated 75% of the gobbeldy gook and adhered to 25% of the factual items, such as water use, utility availability, traffic, air pollution, appearance, and a few more.

C. J. Medema

RESPONSES TO COMMENTS BY
MR. C. J. MEDEMA

1. Please see discussions in Volume 1, subsections III-1 and IV-1.
2. Please see discussions in Volume 1, subsections III-3 and IV-3.
3. Please see discussions in Volume 1, subsections III-9 and IV-9.
4. Please see discussions in Volume 2, beginning pages 77 and 139.
5. Please see discussions in Volume 1, subsections III-3 and IV-3.
6. Please see discussions in Volume 1, subsections III-7 and IV-7.
7. No response required.

Mr. John A. Green, Regional Administrator
Environmental Protection Agency
1860 Lincoln Street
Denver 80295

Dear Mr. Green:

This is with regard to your request for comments relative to the newspaper ads you placed: I would like to suggest that you close up shop, get the hell off the taxpayers back, go home and leave us alone. What say, old chappie, there is still time to save the consumer a great big bundle and stop all this government q CRAP?????? ①

James E. Mogan

RESPONSE TO COMMENTS BY MR. JAMES E. MOGAN

1. No response required.

Environmental Protection Agency
1860 Lincoln
Denver, Colorado 80295

Attention: John Green

Gentlemen:

In response to "It's Your Future; Look Into It", I think you are
doing a wonderful job in letting people know how serious water, air, and
gasoline are. We as a nation have always wasted and now we see that we
won't have as much of everything as in the past. You must realize that
the one most important factor is WATER. You & I cannot survive without
it. Why don't you educated people try & figure a way in which to produce ①
more water; it is the most important subject. I read in the Denver Post
about seeding the clouds in the San Juan area & how much it cost. I as
a tax payer shared in the project & nothing was said about if they cre-
ated more water or if it was a total failure, I believe the amount was
$200,000. I believe that Cloud Seeding is necessary to produce water.
I am sure that God won't object to helping out with this problem. It
is my opinion that there is too much talk and quibbling among you fine
and educated people whom I am sure could solve our (WATER)problem. It
is my opinion if you leave politics out of this problem (water) and get
people involved (I know it's difficult) it's everyone's problem & we
must solve it.

We as a nation are weathy in many ways. I would like to propose that ②
every tax payer or not a tax payer be charged 50¢ a month until there is
enough money in the til to come up with an idea on how to get more water!
We drink plenty of booze, spend money on motorcycles, boats & expensive
homes, etc.; it wouldn't hurt a dam bit to take out 50¢ a month. Just
think of it, the capital you would have?? In regard to gasoline, some- ③
where along the line the issue has become twisted & the people are
confused. If there is a shortage of gasoline, why don't you just say
we are running out of gasoline and other means must be obtained. I
read in the paper a couple of weeks or months ago about "Gasachol" and
it seems feasable when I read the article, and in my opinion if this is
the solution to the gasoline shortage then instead of bickering & criti-
cizing the man or company that invented it, put it on a scale so as to
give the consumer a chance to try it. They mentioned that it would be
64¢ a gallon. Well, for the time being it would be high until it was
perfected better and on a larger scale. As for money, I would again
propose 50¢ per month per individual. We must accept the 50¢ in order
to survive.

Again I will stress that politics stay out of it for the betterment ③
of the people. The people (you & I) work 5 or 6 days a week and we de-
serve to know the real truth about gasoline shortage. I would like to
know why they built th "great Alaska pipeline"? Please give me a frank
answer?. Aside from the gasoline shortage & the water shortage I hope
that you will seriously adopt some of my ideas which would indeed solve
these (2) issues gas & water.

Respectfully yours,
Clarence Paquet

RESPONSES TO COMMENTS BY MR. CLARENCE PAQUET IN HIS FIRST LETTER

1. Please see discussions in Volume 1, subsections III-7 and IV-7.

2. Please see discussions in Volume 1, subsections III-4 and IV-4.

3. No response required because the issues raised by the comment are beyond the scope of the proposed projects and their implications for the region.

Denver, Colo
Aug. 1, 1977

To Mr. Bob Doyle:

Thank you for sending me the literature on Wastewater facilities etc. After reading your book and understanding more about "Pollutants" and various other information on our future needs of water etc. Mr. Doyle, you people are missing the boat on the whole issue of water (especially). As I stated in my previous letter WATER is the main issue over everything ① else; without water you & I will no longer exist and that is a fact! All the material that you people put together is beautiful & it must have taken quite a long time to put together, but on paper it is just a lot of writing & no action. I realize that your hands are tied by the government & all its red tape, but we must eliminate & cut through so as to get the job done. Mr. Doyle, you did not answer some of my questions about seeding the clouds and forcing mother nature to snow in large amounts on our beautiful mountains & thus produce WATER!!! We must assert ourselves and reassure the people that there is enough water for Colorado & maybe other cities will follow our example on how to produce more water. I have read that there is laws governing Seeding Clouds & its impact on other towns and where they (sue) other towns because of the results of producing water. "Mother Nature" plays funny tricks on us humans, but aside from that we must get water & have it available & dam it up so as the future can enjoy what we have done for them.

Aside from talking about water, last Sunday my wife & I were going ① to Church & we saw this couple washing their car with the hose full blast & the children running through the sprinklers with no concern whatsoever about conserving water because they felt they were paying their share of the water & to hell with everybody else, that is the impression we got. We must educate young people as well as the old and its about time to fine people severely so as to get the message home.

The next point of issue is the Car which does pollute the air, no question about it. I believe by eliminating the car from going downtown ② it would help considerably, but how can you do this without hurting people from their jobs, the Car is essential & it is the main tool to make money for the individual so as he can pay taxes etc. - You understand what I am saying? I have a suggestion which may solve yours & mine solution on the pollution from Cars. This would be to erect as many as needed, large fans of some kind to suck in all the pollutants and somehow re-use the pollutant waste for something useful. I realize that it takes money. So what, if we are to survive people must understand the vital necessity of life & that, my friend, is WATER & AIR, P.S., mostly water?

Please don't think that I am a crackpot, I am only interested in the welfare of the whole of U.S. and that is the truth. I love America & for what she is & to see her destroyed by people that don't give a dam is awful sickening. It's high time to tell those type of people get in line or fall out.

Please answer my letter, Mr. Doyle. I would appreciate it very much.

Respectfully yours,

Clarence Paquet

RESPONSES TO COMMENTS BY MR. CLARENCE PAQUET IN HIS SECOND LETTER

1. Please see discussions in Volume 1, subsections III-7 and IV-7.
2. Please see discussions in Volume 1, subsections III-1 and IV-1.

5716 Ammons (At Ralston Road)
Arvada, Colorado 80002
23 July, 1977

Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80295

Attention: Mr. John Green

Dear Sir,

In regard to the Denver Region Clean Water Program, we feel that the "No Funding" solution is not acceptable. We feel there has to be a better, more equitable solution. ①

Sincerely,

Harry & Betty Ann Parmenter

RESPONSES TO COMMENTS BY
MR. HARRY PARMENTER AND MRS. BETTY ANN PARMENTER
23 JULY 1977

1. EPA agrees. See Volume 1 of this final EIS for an explanation of what EPA proposes to do.

July 17, 1977

955 South Columbine Street
Denver, Colorado 80209

Mr. Robert Doyle
Region VIII Office
Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Dear Mr. Doyle:

I am writing to express my strong opposition to the use of EPA grant funds for the design, construction and expansion of wastewater facilities in the Denver region. It seems evident from reading the "Denver Regional EIS for Wastewater Facilities and the Clean Water Program" that it would be counterproductive for EPA to fund activities that would, as a consequence of secondary impacts, have a net effect of degrading environmental quality. ① ②

The EPA should be the first to recognize that the front range of Colorado, particularly the Denver region, has a finite "carrying capacity" determined primarily by the availability of water, natural gas and other resources and by the capacity of the atmosphere to deal with auto and other emissions. It seems fairly obvious that the carrying capacity of the Denver region has already been surpassed -- air quality is now comparable with, if not worse than, that of Los Angeles; the demand for raw water exceeds the supply, severely so in times of drought; natural gas shortfalls are expected within five years; due to the overuse of nearby National Forests, permits may soon be required to hike or camp; and so on. With each attempt to push carrying capacity beyond its reasonable limits, quality of life suffers. ②

In light of the adverse impacts identified in the EIS, I strongly urge that EPA NOT fund any design, construction or alteration of any wastewater treatment facility if such construction or alteration will result in an increase in operating capacity beyond what is needed to serve present population levels. Funding under these conditions would be counterproductive to EPA's involvement in air quality control and would adversely effect the quality of life in the Denver region. ①

I would like also to express my concern over the manner in which Denveris depicted in the draft summary EIS and in the accompanying slide presentation. Both indicate that, as the region grows, physical and economic decay of the urban core in inevitable. The EIS contends that the affluent will take flight to the suburbs, leaving in their wake a population of indigents. Such statements seem to be somewhat contrary to recent trends -- Denver's CBD is in the midst of the biggest and most impressive building boom in its history. Young, affluent individuals and families, dissatisfied with the humdrum of suburban living, are moving backinto the core in substantial numbers and rehabilitating the housing stock. Too often -- and hopefully not in Denver's case -- statements about the long-term viability of urban centers become self-fulfilling prophecies. ③

I hope these comments will be given careful consideration in formulating policies for the funding of wastewater facilities in the Denver region. Thank you very much for the opportunity to comment.

Sincerely,

David A. Wicks

David A. Wicks

RESPONSES TO COMMENTS BY
MR. DAVID A. WICKS
17 JULY 1977

1. EPA has decided that the no-funding alternative is not appropriate. See Volume 1.
2. Please see discussions in Volume 1, subsections III-1, 7, 8 and 9, and IV-1, 7, 8 and 9.
3. Please see the information added to "Population" in Section II, Volume 2 (p. 69, paragraph 1).

VI. Glossary and Bibliography

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SECTION VI

GLOSSARY

Activated sludge--A process which removes organic matter from sewage by saturating it with air and adding biologically active sludge.

ad valorem tax--A general property tax levied annually on real and personal property as listed with the county assessor.

Aerosol--A suspension of fine solid or liquid particles in a gas. In wastewater treatment processes involving spraying, aerosols can transport micro-organisms and dissolved liquids in the wind for considerable distances.

Aggregate--Any of several hard, inert materials, such as sand, gravel or slag, used for mixing with a cementing medium to form concrete, mortar or plaster.

Agricultural multiplier--A term which describes the number of times money generated by the agriculture sector of a regional economy changes hands before leaving that economy.

Anaerobic digester--A type of equipment used to digest sludge in the absence of oxygen to reduce the volatile organic material to methane gas by microbial activity.

Aquatic environment--The ecologic conditions extant in the region's streams and water bodies.

Aquifer--A water-bearing stratum of porous rock.

Benthic organisms--Organisms which live on the bottoms of water bodies.

Berm--A structure resembling a dike which is used as a means of physical separation.

BOD_5--An abbreviation representing the amount of oxygen required for the biological decomposition of dissolved organic solids to occur under aerobic conditions for five days at 20°C.

Braided stream--A stream with an interlacing network of channels.

Brown-out--A period of reduced illumination resulting from demands for electric power which exceed generating capacities.

Carbon monoxide (CO)--A very toxic, colorless and odorless gas.

Carrying capacity--A relationship reflecting the number of animals and/or humans that a given unit of land can support without a substantial degradation of that land unit's extant conditions.

cfs--An abbreviation for cubic feet per second. It is a unit of measurement commonly used to describe volume of streamflow.

Dewatering--A process where sewage is reduced in volume by removing a portion of its water content.

Diurnal--A term used to describe a 24-hour cycle.

Effluent--The liquid that comes out of a treatment plant after completion of the treatment process.

Emissions--Substances discharged into the air.

Environmental limitations--Those features of a defined area of land which could be degraded if new land uses were introduced.

Environmental opportunities--Those features of a defined unit of land which provide distinct advantages to certain introduced land uses.

Epidemiological--The sum of the factors controlling the presence or absence of a disease or pathogen.

Eutrophication--A process by which a body of water becomes overly rich in nutrients and deficient in oxygen.

Fugitive dust/particles--Dust and soil particulates carried by winds away from an earth disturbance.

Gaussian plume model--A mathematical model used to predict the distribution and dilution of air-borne substances from stationary sources.

General obligation bonds--Bonds secured by the full faith and credit and by the general taxing power of the issuer.

Holistic--A view that nature is correctly seen in terms of interacting wholes that are more than the mere sum of elementary particles.

Hydrograph--A graphic presentation of quantified streamflow characteristics.

In-lieu of fees--As used in this document, recreation facility in-lieu of fees would be payed by residential developers, if they were not required by local jurisdictions to provide outdoor recreation facilities within their developments. The monies collected would be used by local jurisdictions to develop parks and playgrounds.

Interceptor--Interceptor sewers in a combined system control the flow of the sewage to the treatment plant. In a storm, they allow some of the sewage to flow directly into a receiving stream. This protects the treatment plant from being overloaded in case of a sudden surge of water into the sewers. Interceptors are also used in separate sanitation systems to collect the flows from main and trunk sewers and carry them to the points of treatment.

Intermittent stream--A stream which flows only during a part of a year. This contrasts with perennial streams which flow all year and ephemeral streams which carry only stormflows.

Inversion (temperature)--A reversal of the normal atmospheric temperature gradient.

Isopleth--A line on a map connecting points at which a given variable has a specified constant value.

Mill levy--An ad valorem tax.

Mini-NEPA laws--State and local laws, such as the California Environmental Quality Act, which are modeled after the National Environmental Policy Act to assure environmental review of state and local actions which might adversely affect the quality of the environment.

NO, NO_2 and NO_x--Oxides of nitrogen which are significant contributors to the formation of photochemical smog.

Non-point source--An activity distributed over a wide area that is a source of pollution.

Nonstructural control measures--Regulations and maintenance activities which reduce the production of pollutants without relying on equipment or facilities specifically designed to reduce the target pollutants.

Ozone (O_3)--A major agent in photochemical smog.

Particulate matter--Any material, except uncombined water, that exist in a finely divided form as a liquid or solid.

Perturbation--As used in this document, a perturbation is a hypothetical disturbance or change to extant conditions for the purpose of comparative modeling.

Point source--A stationary, readily identifiable pollution source.

Potable water--Drinkable water.

Precursor--A substance from which another substance is made.

Prototype meteorological day--A day whose quantified weather characteristics are representative of an area. These characteristics are used in mathematical models of air pollution conditions.

Radiation fog--A ground fog produced when the dew temperature (point of condensation) is reached through direct radiation of ground heat.

Revenue bonds--Bonds secured by a pledge of revenue which is to be derived from the operation of a public facility.

Rilling--A form of water erosion where very narrow and shallow furrows are created on exposed ground surfaces.

Riparian corridors--Biotic communities along stream courses used by wildlife as movement corridors.

Riparian habitat--A streamside biotic community.

Sedimentation--The process of particulates settling out of their transporting medium, e.g., silt, sand and gravel settling to the bottom of a stream.

Sediment load--The amount of particulates carried in a transporting medium.

Seismic activity--Earth shaking and movements.

Septic tank leachate--The incompletely treated liquid component of sewage processed by a septic tank.

Service/user charges--A regular charge levied on sewer system users by a responsible agency for the provision of services.

Setbacks--A land use restriction commonly employed for a number of health, safety and environmental reasons to prevent or limit construction in a given area, ususally to provide a buffer zone.

Shedding--Load shedding is a prearranged action by electrical power supplier and its major consumers where voltage is cut back by the supplier to the consumer or power demand is reduced by the consumer to prevent system-wide power shortfalls.

Sheet erosion--Soil erosion where water draining from an exposed ground surface does so in wide, even "sheets" and thus does not form any rills, rivulets or gullies.

Shortfall--As used in this document, a shortfall is a failure to meet an energy need.

Shrink-swell--A characteristic of soils containing clay which describes the range of volumes per unit weight of soil under wet and dry conditions.

Sludge--Sludge is the solid matter that settles to the bottom, floats or becomes suspended in the sedimentation tanks and must be disposed of by filtration and incineration or by transport to appropriate disposal sites.

SMSA, Standard Metropolitan Statistical Areas--Geographical units of land established by the U.S. Census Bureau to aid in its population data collection and analysis activities in urban areas.

Stationary sources--Nonmobile air pollution sources, e.g., refineries and factories.

Steppe--An arid, mid-latitude continental natural region characterized by vast, flat and treeless expanses.

Strata--Sheets of sedimentary rock or earth covering one another.

Stream channelization--A human activity intended to modify natural stream channels to increase their volumes of flow.

Structural control measures--Facilities or equipment, such as wastewater treatment plants, which are specifically designed and constructed to abate a given pollution problem.

Subsidence--An event or occurrence where the ground surface settles or sinks to a new level.

Suspended solids--The small particles of solid pollutants which are present in sewage and which resist separation from the water by conventional means.

Synergistically--Several discrete agents having the ability to cooperate such that the total effect is greater than the sum of the agent's effects taken independently.

Tap fees/Connection fees--Initial fees charged by a sewer agency to allow connection to a sewer system.

Transition Life Zone--A term categorizing environmental characteristics found between 5,500 feet and 8,000 feet elevation.

Trickling filter--A support media for bacterial growth, usually a bed of rocks or stones. The sewage is trickled over the bed so the bacteria can break down the organic wastes. The bacteria collect on the stones through repeated use of the filter.

Upper Sonoran Life Zone--A term categorizing environmental characteristics found between 3,500 feet and 5,500 feet elevation.

Volatilization--A process whereby a liquid is caused to atomize or evaporate quickly.

Wildfire--Uncontrolled fire in undeveloped areas such as forests, brushlands and grasslands.

Wind corridors--Stream valleys descending out of the mountains onto the plains where valley depressions channel downslope winds. These channeled winds attain higher velocities than winds found elsewhere in the area due to Venturi effects resulting from the constricting stream valley landform.

Windrow--Linearly planted, closely-spaced trees utilized as a wind barrier.

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